DOCUMENT RESUME

ED 167 357 SE 026 344

TITLE IECL Energy Conservation Material Package.
INSTITUTION Colorado State Dept. of Education, Denver. Interstate Energy Conservation Leadership.
SPONS AGENCY Bureau of Elementary and Secondary Education (DHEW/OE), Washington, D.C.
PUB DATE [75]
NOTE 152p.; Contains occasional marginal legibility

EDRS PRICE MF-$0.83 HC-$8.69 Plus Postage.
DESCRIPTORS Building Operation; Curriculum; *Energy Conservation; Maintenance; *Management; Operating Expenses; Planning; *School Buildings; *School Districts; *State Departments of Education; Transportation

ABSTRACT

This publication presents information on how schools and school districts can save energy. The energy conservation materials contained in this package are organized into two sections. The section titles are: (1) Towards a State Education Energy Policy; and (2) Materials for Distribution to School Districts. Topics presented in the first section include: (1) school finance; (2) the role of state education agencies in energy conservation; (3) state energy conservation action plans for school facilities; and (4) energy conservation in the curriculum. The second section includes an outline for a district-level plan for energy management and a discussion of energy conservation techniques for school transportation operations. (MB)

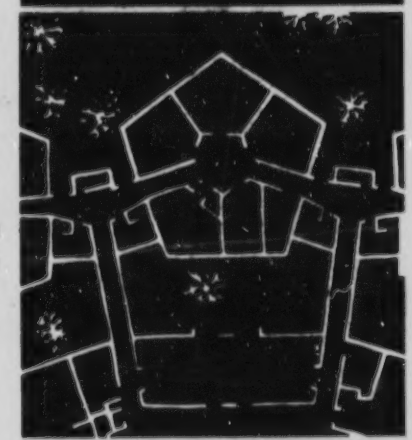
****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

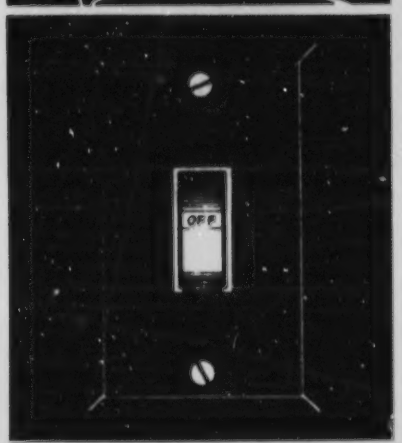
000 156

M Robinson

ED167357

ENERGY CONSERVATION MATERIALS PACKAGE





U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

Sponsored by the Colorado Department of Education with participation from the states of Massachusetts, North Carolina, and Washington

PRODUCED BY THE INTERSTATE ENERGY CONSERVATION LEADERSHIP PROJECT AN ESEA SECTION 505, TITLE V-A PROJECT

SE 026 344

IECL

ENERGY CONSERVATION MATERIAL PACKAGE

PRODUCED BY THE

INTERSTATE ENERGY CONSERVATION LEADERSHIP PROJECT

sponsored by the

COLORADO DEPARTMENT OF EDUCATION

with participation from the states of

MASSACHUSETTS NORTH CAROLINA WASHINGTON

AN ESEA SECTION 505, TITLE V-A PROJECT

Dr. Calvin M. Frazier, Commissioner

COLORADO DEPARTMENT OF EDUCATION
201 E. Colfax Ave.
Denver, CO 80203

COLORADO STATE BOARD OF EDUCATION

Mrs. Robin Johnston, Chairman . . . . . Denver
(First Congressional District)

Lewis E. Stieghorst, Vice-Chairman . . . . . Littleton
(Second Congressional District)

Bill Graham . . . . . Beulah
(Third Congressional District)

Allen B. Lamb . . . . . Windsor
(Fourth Congressional District)

Mrs. Betty Feilbert . . . . . Aurora
(Fifth Congressional District)

INTRODUCTION

The enclosed energy conservation materials were produced by the INTERSTATE ENERGY CONSERVATION LEADERSHIP PROJECT (IECL) in the belief that state education agencies can play a key role in the conservation of energy. By promoting conservation programs, state agencies can help to slash the energy bills of local school districts, thereby saving tax dollars. By reducing energy consumption within school systems, state agencies can make a significant contribution to the national conservation effort. Even more important, by helping to instill a conservation ethic in today's youth, SEAs will make a contribution to the nation's future.

The IECL, funded out of the U.S. Office of Education and operating through the Colorado Department of Education, was organized in response to a number of difficulties posed to the nation's school system by the energy crisis and by the resulting high cost and low supply of energy resources. During the past year IECL has been active in promoting energy conservation programs within state education agencies. Working in cooperation with the states of Massachusetts, North Carolina, Washington, and the FEA, IECL sponsored a series of national conferences on energy. As a part of these conferences, workshops in school transportation, facilities, and curriculum were conducted. Personnel from the National Science Teachers' Association, Educational Facilities Laboratory, and the National School Transportation Association conducted these workshops. Many of the materials in this package were produced as a result of conference workshops and general sessions of the IECL conferences.

NOTE: None of the materials in this package is copywrited. State education agencies are encouraged to duplicate and distribute these materials under their own cover sheets. Moreover, state and local education agencies may remove segments of these materials or add materials more relevant to their own energy situation.

ACKNOWLEDGMENTS

We wish to extend our special thanks to the following persons for their cooperation and assistance in producing these materials:

Dr. Calvin M. Frazier, Commissioner
Colorado Department of Education

Stanley A. Leftwich, Chairman, IECL and
Assistant Commissioner
Colorado Department of Education

Robert Thomas
U.S. Office of Education Project Officer

John Baird
Energy Consultant for USOE
U.S. Office of Education

Carsie K. Denning, P.E., and Tom O'Kelley
North Carolina Office of Superintendent
of Public Instruction

David Kennedy
Washington State Office of
Superintendent of Public Instruction

Leo P. Turo
Massachusetts Department of Education

William (Red) Reynolds, Director
National School Transportation Association

Joshua Burns and John Boice
Educational Facilities Laboratories

John Fowler
National Science Teachers' Association

Edward Stephan
Federal Energy Administration

Erik Svenson
Federal Energy Administration

Doris Ross
Education Commission of the States

Dennis Bakke
Federal Energy Administration

ACKNOWLEDGMENTS (cont'd)

S. David Freeman, Special Consultant
to the Senate Commerce Committee

Jonathan Wert
Tennessee Valley Authority

Dan Regan
Montana Power Company

Calvin E. Anderson
Project Director
INTERSTATE ENERGY CONSERVATION
LEADERSHIP PROJECT

King C. Kryger
Assistant Project Director
INTERSTATE ENERGY CONSERVATION
LEADERSHIP PROJECT

A NOTE ON THE IECL CLEARINGHOUSE

The Interstate Energy Conservation Leadership Project maintains an energy conservation clearinghouse, established and operated for the specific purpose of assisting state education personnel with energy matters.

State education agencies are encouraged to contribute to this clearinghouse and to use its facilities in developing their own energy conservation programs.

For further information contact:

Dr. King C. Kryger
IECL CLEARINGHOUSE
Colorado Department of Education
201 E. Colfax Ave.
Denver, CO 80203

Telephone (303) 892-2214

Direct requests for materials should be addressed to:

Mrs. Coila Pottorf, Clearinghouse Librarian
Colorado State Library
1362 Lincoln St.
Denver, CO 80203

Telephone (303) 892-2171

HOW TO USE THE IECL ENERGY CONSERVATION MATERIALS PACKAGE

The energy conservation materials contained in this package are organized into two sections:

I. TOWARDS A STATE EDUCATION ENERGY POLICY, and
II. MATERIALS FOR DISTRIBUTION TO SCHOOL DISTRICTS

The following Annotated Table of Contents describes these two sections:

AN ANNOTATED TABLE OF CONTENTS

SECTION I. TOWARDS A STATE EDUCATION ENERGY POLICY

1. The Impact of the Energy Crisis on School Finance. An Issue Paper for the National School Finance Conference, New Orleans, Louisiana, March 3 and 4, 1975. This paper describes the trend of energy costs and their impact on the school budget. It contains practical suggestions on what can be done to counter the corrosive force of high energy costs.

2. What a State Education Agency Can Do about Energy Conservation. The energy crisis is not going to disappear. High energy costs will continue to trouble school administrators in the years to come. Energy problems, however, offer the chance for state leadership. This list of suggestions describes some of the steps that state-level administrators can do to encourage energy conservation.

3. A State-level Action Plan for the Conservation of Energy in School Facilities Operation and Maintenance. This document provides a framework for the organization and implementation of a state-level conservation plan. SEAs are encouraged to use this type format in designing their own conservation program.

4. Energy Conservation in School Facilities. A look at the latest energy conservation techniques being used in school facilities, including the use of solar energy, the techniques of life-cycle costing, and the upgrading of mechanical systems.

SECTION I (cont'd)

5. Energy Conservation in the School Curriculum. Notes on the problems encountered in introducing conservation as a subject area in the school curriculum, together with some ideas on how these problems can be overcome.

6. A List of IECL "Energy Contacts." A list of persons who, through their participation in IECL conferences and other activities, have shown an interest in energy conservation and education.

SECTION II. MATERIALS FOR DISTRIBUTION TO SCHOOL DISTRICTS

1. Energy Conservation in School Facilities. Practical energy-saving strategies for district-level facilities planners, operation and maintenance personnel, and others concerned with the energy systems in school facilities.

2. An Outline for a District-level Plan for Energy Management. This format may be used by school districts in developing an energy conservation program. It includes a comprehensive list of energy-saving ideas.

3. Energy Conservation in the School Curriculum. This segment contains a speech by S. David Freeman delivered at the IECL conference in Boston. The speech describes the importance of energy conservation for educators and provides the philosophical basis for the teaching of energy conservation in the schools. Included also is an IECL bibliography of conservation materials developed by state education agencies.

4. Energy Conservation in School Transportation Systems. Conservation techniques in school bus transportation and driver education programs, including a list of energy conservation suggestions.

SECTION I

TOWARD A STATE EDUCATION ENERGY POLICY

TOWARD ESTABLISHING AND IMPLEMENTING A STATE EDUCATION ENERGY POLICY

In the process of sponsoring four national conferences on energy conservation, the IECL learned that many state education agencies were caught off-guard by the energy crisis. Even after the initial shock waves of the crisis had subsided, many state agencies lacked the funds or the personnel to deal effectively with energy problems. An IECL survey of 50 states revealed that few state education departments employed a person whose sole responsibility was in the area of energy. The same survey showed that only two states had the financial capacity to deal with energy problems.

It is to be hoped that the lessons learned from the energy supply crisis, and the financial difficulties that resulted, will be put to good use so that educators will be prepared to meet future problems. The following list of suggestions describes actions that SEAs can take to insure a greater awareness of the role of energy in education and to prepare for future energy crisis situations.

WHAT SEAs CAN DO

1) Share the information acquired from all sources with your chief state school officer, local school district personnel, and others interested in energy conservation.

2) Train staff people who visit districts to be "energy mini-experts"--this will enable them to provide limited assistance in district energy conservation programs as well as to be a "reporter" to state departments or district energy conservation successes and failures.

3) Hold regional workshops on energy conservation. Encourage local districts to conduct their own roundtable discussions.

4) Check into the availability of federal and state funds for energy conservation programs. See what you can do about securing an energy coordinator in your state department of education.

5) Ask cooperative districts to provide your state department with hard information. Examples of this information could be cost-benefit figures based on uniform comparisons in energy conservation efforts; evaluation of new energy conservation curriculum materials, etc.

6) Advise local school boards about the economy of "life-cost" bids on new facilities as opposed to "first-cost" bids. Inform them of the year-round school concept as a method of fully utilizing existing buildings.

7) Investigate the potentials of solar heating and cooling for new buildings and for existing facilities.

8) Encourage the hiring of competent maintenance personnel and encourage the promotion of salary scales that will attract such personnel.

9) Support efforts to promote energy conservation training programs and workshops for maintenance personnel now on the job.

10) Encourage programs that will provide for the retrofitting of existing facilities in order to create more energy-efficient buildings.

11) Encourage the purchase of energy-efficient equipment.

12) Encourage the review and, where possible, the revision of existing building codes to make them energy efficient.

13) Using periodic news releases, tell the people in your state what the education world is doing about the energy problems. Show how the individual can apply energy conservation measures used in schools. Check with television and radio stations about producing "specials" on energy conservation in schools; include a program on how and what children are learning about energy and their environment. Relate these to dollar savings.

14) Design a catch phrase or special symbol to identify your state's energy conservation effort, and use it at every opportunity.

15) Establish a state-level clearinghouse on energy matters. This clearinghouse can collect energy consumption data from school districts and disseminate information on energy conservation to local school districts.

16) Make use of the IECL clearinghouse in developing conservation programs. Make available to the IECL clearinghouse reports on energy conservation programs in your state, so that they can be used in other states.

17) Plan to send representatives to the IECL regional energy conservation workshop to be held in your area within the coming months (dates and locations to be announced).

A STATE-LEVEL LOOK AT THE IMPACT OF THE ENERGY CRISIS ON SCHOOL FINANCE

THE IMPACT OF THE ENERGY CRISIS ON SCHOOL FINANCE

Energy problems over the past several years have spawned an army of energy experts and a library full of statistical information. An endless stream of energy information bombards us daily. Every dark corner of American energy use patterns has been studied so thoroughly that we are now at the point where we are researching our own research. Newspapers and television news broadcasts are seldom without some reference to energy problems; and there must be hundreds of occasions weekly in the United States such as this one, where somebody is asked to make a speech on some facet of energy problem. For these reasons anyone asked to address a public gathering on this subject runs the risk of repeating what has been said hundreds of times before. I cannot completely avoid this problem, but I would like to try to defuse it somewhat by concentrating my focus on the energy crisis as it affects public education and by sharing with you what I have learned as the project director of the INTERSTATE ENERGY CONSERVATION LEADERSHIP PROJECT.

It appears that the impact of the energy crisis on the schools cannot be discussed apart from the energy problems confronting society at large and this, in turn, cannot be considered without some reference to the energy consumption patterns of the American public. These facts are worth repeating because the situation basically remains unchanged.

America's foolish squandering of energy and its dangerous reliance upon foreign oil reminds one of Mark Twain's comment that man is the only animal that blushes--or needs to.

The most astounding feature of the American energy picture has to do with the rate of American energy consumption compared to that of the rest of the world. Americans use five times more energy per capita than any other people in the world. The energy wasted by 205 million Americans is the total energy used by 105 million Japanese. We consume more energy on air conditioning than 800 million Chinese people use for every other purpose. The average West German, although he enjoys the same standard of living as the average American, consumes 42% as much energy. The most often-repeated fact concerning American energy use is that although we have 17% of the world's population, we consume 30% of its energy. But the saddening thing about this statistic is that in the last three years since the initial energy crisis, it has not changed one percentage for the better.

There is no indication whatsoever that Americans have made any significant cutback in the energy that we use and waste. A study done several months ago indicated that the United States is consuming 17.6 million barrels of oil daily--this is 1.1 million barrels higher than in the eighteen months previous to this time. Moreover, oil imports have been increasing: Imports five years ago were averaging 3.4 million barrels per day. Today the average is 6.2 million barrels--about 38% of what we use. President Ford would like the United States to be self-sufficient by 1985 but if this trend, I just mentioned, continues the United States will have to import 50% of its oil by 1980. This pattern of energy consumption and importation has led Assistant

Secretary of State Thomas Enders to remark that "unless the U.S. acts to conserve energy we face a rising danger of financial collapse or depression, or both, over the next decade." Measure in your mind what this would do to our education system.

Mr. Enders' gloomy forecast states a basic problem. It is a problem that should be obvious but that usually goes unnoticed. I refer to the underlying psychological attitude of the American public toward the use of energy--an attitude that allows for us to continue to guzzle gas, to waste fuel oil, and to squander electrical power. As educators we must understand that behind the mountain of energy statistics, behind the political bickering about policy, and behind all of the rhetoric surrounding the energy problem lurk misguided attitudes and blatant misconceptions regarding the earth's capacity to sustain abuse.

What all of these attitudes add up to can perhaps simply be characterized as "bad habits." As innocent as this may seem, "habit" implies inflexibility, and history has indicated that nothing is apt to bring a great power to its knees faster than an inability to adjust to change. Commenting on the need for a national effort to change our energy consumption patterns, Secretary of State Kissinger said that our very liberty is at stake.

These bad habits of which I speak form the basis of our entire energy picture. This fact is worth stressing here at the outset because it appears that if school officials are to deal effectively with their energy problems it would be well to understand the sources of these problems; otherwise they may be treating symptoms instead of root causes. Unless they are aware of these root causes, school administrators are particularly vulnerable to difficulties created by the energy crisis. As one energy expert explains, "The private sector can usually write off or pass on increased energy costs, but schools cannot. The money comes from a tax increase or an educational cutback--both deadly to school boards, superintendents, and students."

The nation's bad habits and the energy crisis which resulted from these habits have had serious consequences for the nation's educational system. America's schools house nearly 25% of the nation's total population on any given school day. American schools consume 11% of our nation's space heating and cooling energy. School buses consume 500 million gallons of gasoline are consumed in driver training programs.

In one way or another the use of energy in the schools touches the lives of every citizen. In many states the public school system is the largest single employer, manages the largest food service operation, operates the largest transportation system, and houses the largest number of people on a day-to-day basis of any other single institution in the state.

In spite of the vulnerability of the educational system to high energy costs and energy scarcity, the IECL found in some of its preliminary investigations that the nation's schools were largely unprepared for the barrage of energy problems that have befallen them. For example, an IECL

survey of the fifty state departments of education indicated that only one state had money in its budget aimed specifically at energy problems. Moreover, we found that a relatively small percentage of state departments of education had developed significant energy conservation programs. ("Significant" here means that a program is comprehensive in scope and that it reaches a large segment of the school population within the state.) Finally, there is, to our knowledge, no state department of education fortunate enough to have one person whose sole responsibility it is to handle energy-related problems.

This general state of unreadiness had predictable results when the energy "crunch" finally came. In hearings conducted in January of 1974 the Senate Subcommittee on Education, heard testimony to the effect that rising costs of fuel for space-heating and buses have thrown many districts into confusion or consternation. The subcommittee heard the following examples of this consternation: In Massachusetts one school district reported that heating fuel would cost the system nearly $12,000 more than anticipated. An Ohio school district reported that the estimated cost of running their fleet of 28 buses would go up $14,000 over the previous year.

More recent statistics gathered by IECL show an even more alarming trend in energy costs to the schools. A superintendent of one Pennsylvania school district, completely dependent upon coal, reported in November of 1974 that the cost of coal had risen from $14.20 a ton in 1973 to $38 a ton in 1974. Another Pennsylvania district discovered that the $72,000 it had budgeted for fuel oil was $35,000 short of its actual expenses. In my own home state of Colorado, where schools were closed for a time one winter due to an oil shortage, the situation appears no better. In the Canyon City school district the price of gasoline in two years has risen 121%; in one year the cost of natural gas in the same district has risen 45%, and their electrical bills have risen 52%.

But in spite of the burdens of rising energy costs, many school districts around the nation have not yet felt the full force of the energy crunch. Those districts lucky enough to be blessed with abundant local energy sources have reported no undue hardship. One can only hope that these districts do not get lulled into a sense of complacency, for the worst appears yet to come.

Recent trends in governmental energy policy making--including the unrestricted deregulation of natural gas, and the proposed 15 cent-per-gallon hike in gasoline prices--would indicate that the past energy problems of the schools are minor compared to what is in store. Noting that the state's cost of fuel for student transportation last year was $5 million higher than anticipated, Massachusetts Commissioner of Education, Gregory Anrig, expressed alarm that the rate of inflation is rising faster than state or federal aid and added, "I think we are in for very stringent times." I might add that I believe this is true of almost every state.

By simply playing with a few of the figures that I have already quoted, you can begin to understand how stringent times may become. The 518 million gallons of gasoline consumed by the country's school buses and

driver training programs will cost $77,700,000 more in the coming year if the FEA proposal for a 15¢ per gallon hike is approved. If the price of natural gas is arbitrarily deregulated, the cost to those schools dependent upon this form of energy could be enormous. A conservative estimate is a 300% hike by 1985. The higher costs resulting from the proposed policies would have an inflationary effect upon almost every item used by schools from ball-point pens to ditto fluid.

Unfortunately, what many people fail to realize is that there is a direct and corrosive relationship between the dollars-and-cents energy costs to the schools and the type of educational programs they can provide. It is only a matter of time before the inflationary costs of energy will begin to eat into the quality of our educational curricula and into the teacher's paycheck. Herein lies the real threat posed to the nation's educational system by the energy problem. And this is why we must, without further delay, consider the means by which we can lessen the impact of energy costs before the educational process begins to erode.

What can be done to buffer this impact? On the federal level what is needed, of course, is a sound national energy policy to replace the fruitless bickering and political in-fighting that now exists between congress and the administration. We also need federal aid to support energy conservation programs in the schools. But as we all know, the federal bureaucracy, even at its best, is a sluggish beast, and school districts around the country may well go broke trying to pay their fuel bills if they simply wait for the federal government to recognize the schools' energy problems and to act in a positive manner. In fact, given the tactics that it has applied so far, there is some reason to doubt that the administration will ever be able to formulate a responsible energy policy. In the view of one author, "Getting large numbers of people to change their daily habits presents an enormous and complex challenge, even to a highly popular leader, under ideal conditions. Until the current economic crisis grows considerably worse, or until some major economic reforms take place, buttons and slogans will never work as well as realistic incentives." As educators we must get our own energy house in order.

I think, to start with, we must realize that regardless of what economic policies the government finally decides upon, the high costs of energy that school finance people must face every month are not going to disappear suddenly. This is because energy costs reflect waste as well as scarcity; and energy waste, as I pointed out earlier, has become an ingrained habit with too many educators. It will take time and patience to change these bad habits, but the question remains: What can school budget officers do to help cut down on energy costs? There is a great deal that you as school budget officials can do to encourage the conservation of energy and reduce your fuel bills:

1. Encourage your district to initiate at once a comprehensive energy audit to determine patterns of energy use. An energy audit is an indispensable tool in any conservation program. It has the following advantages:

--it shows where energy money has gone and therefore pinpoints areas where energy savings are possible by providing monthly energy cost comparisons.

--it makes possible the preparation of an "energy budget" so that administrators can begin to think of dollars and BTUs in the same terms.

--an energy audit, by showing graphically where energy costs are concentrated, encourages students, teachers, and administrators to try harder to cut energy waste.

2. Encourage the hiring of competent maintenance personnel and encourage the promotion of salary scales that will attract such personnel. Monies spent for this purpose will be recovered many times over.

   The days when the main function of the janitor was to empty waste baskets, sweep floors, and act as a kindly grandfather figure to the students are over.

   Modern heating, ventilating, and air-conditioning equipment are complex and sophisticated. It takes special skills to operate this equipment efficiently. Custodial hiring practices in most places have not kept pace with the level of expertise required to operate an energy-efficient school.

3. Support efforts to promote energy conservation training programs and workshops for maintenance personnel now on the job.

   Even though many conservation techniques are no more complex than turning off lights, techniques such as this must be brought to the attention of custodial personnel, otherwise the effect upon the monthly electricity bill can be disastrous. An example: the Educational Facilities Laboratory reports that in one school, between 4 P.M. and midnight, when the school's normal daily population of 1,000 shrunk to three custodians, the school consumed 30% of its total energy. Merely by switching off the lights and the heating, ventilating, and air-conditioning system in local areas as they finished their work, the custodians could have cut the school's workday electric power consumption by 15 to 20 per cent.

4. Encourage the consideration of life-cycle costing in the planning of new educational facilities. Too often American schools are built on the basis of low initial costs. Although this seems like a good practice to the taxpayer, it often results in buildings that are energy wasteful and which actually squander tax dollars over a period of time. The energy crisis is teaching educators that "nothing is so expensive as when it is cheap."

An example of life-cycle cost effectiveness: In the Fairfax county school system, the school board agreed to reject the low first cost bid for one HVAC system in favor of another which cost 10% more. The winning system will slash an estimated $356,000 from the 20-year operating cost.

5. Encourage programs that will provide for the retrofitting of existing facilities in order to create more energy-efficient buildings.

   Essentially, "to retrofit" means to replace, rebuild, and install equipment and materials that will insure less energy waste. Retrofitting may involve relatively large expenditures, such as the complete replacement or rebuilding of an existing HVAC system. But in most instances the process can be relatively simple and inexpensive, involving adding insulation, caulking leaky air ducts, walls, and window frames, and replacing worn-out equipment parts.

   A modest retrofitting program can cost relatively little and be undertaken without the advice of "experts." (Lennox Industries, for example, report that the expenditure of $1 for air-conditioning equipment maintenance can yield nearly $6 savings in operating costs.) In other cases, where circumstances dictate and where funds are available, it may be wise to consult an engineer familiar with energy conservation techniques. A return on an initial investment made for retrofitting is almost always assured.

6. Encourage the purchase of energy-efficient equipment. An energy efficient piece of equipment may have a higher first cost but may pay for itself several times over in the long run. Some examples would be:

   --appliances which use less energy
   --efficient food service equipment
   --efficient electrical office equipment, and
   --bus and driver training vehicles with good gasoline mileage

   One expert states that no school should be built without incorporating the potential of solar energy.

7. Encourage the review and, where possible, the revision of existing building codes to make them energy efficient.

   Many states have regulations on lighting and ventilation that place unnecessary burdens on energy systems. A complete energy study of the New York City School System, for example, showed that substantial savings where possible by reducing lighting and ventilation below the prescribed

standards. The report (written by Richard G. Stein & Associates for the New York City Board of Education) concluded that there is no correlation between higher light levels and educational achievement, and that there is no dangerous change in air quality with ventilation less than a third the present prescribed level.

One reason why I recommend these measures to you is that they have had proven results, and I am pleased that I can supplement the stories I told you earlier with some success stories. One small Colorado school district (Northglenn), through careful auditing of its energy usage patterns and through an organized program of energy conservation, is now saving in excess of $3,000 per month on its gas and electric bills. The State of Texas, which has one of the most sophisticated energy audit systems in the country, has reported that energy consumption by school districts is down 13.1% from what it was in 1973. One Long Island school district (the Herricks School District in New Hyde Park) anticipates a 20% reduction in the use of fuel oil through its installation of a more efficient heating system and other energy saving devices. The president of the board of education there noted that the district can expect to save $16,000 of its $80,000 a year school bill.

These kinds of reductions can often make the difference between an average or quality education program. After teacher contracts are signed, the only areas left to absorb the dollar loss are supplies, equipment, and supporting services. These areas are normally already cut to the bone and cannot readily absorb these overw helming new energy costs.

The recent statements by a nationally recognized organization that the greatest contribution to inflation was tax increases is not good news for school districts. Schools are traditionally the tax "whipping boy" for people. Higher costs and declining enrollments will be difficult enough to cope with. Unwise use of energy need not be added to this list.

To briefly summarize--the energy problem and its financial impact is larger than education. But as educators and as citizens we must all do our share in conserving energy and the dollars energy represents. By auditing our energy usage, by taking very practical steps toward conservation, by retraining our thinking and our personnel, we can begin to make some headway on this impact.

As educators, we have an obligation to the children we serve and to their children, to leave them energy resources. When frustration, doubt, and apathy make you want to throw up your hands in dispair, remember the lamp of knowledge burns oil--without it--it might go out.

A STATE LEVEL PROGRAM FOR ENERGY CONSERVATION IN SCHOOL FACILITIES: OPERATION AND MAINTENANCE

PREFACE

The following is a suggested plan of action for a state-level energy conservation program designed for use in public school systems. Some of the steps of the plan appear to be unimportant, but, nevertheless, provide continuity to the program.

The tabulated action plan sheet on the first few pages contains not only the steps to be taken but also indicates individuals having responsibility for these tasks. Scheduled dates and a column for completion dates are also shown.

Obviously this program will not apply totally to all state education departments. The intent is to provide a flexible framework for a workable and effective statewide energy conservation program in education.

For a more complete idea of energy conservation programs, the reader should also consult the district-level plan in Section II of this package.

STATE DEPARTMENT OF PUBLIC EDUCATION

APPROPRIATE OFFICE

ACTION PLAN (SAMPLE)

1-21-75		
Original Date	Revision Number	Revision Date

PERIOD COVERED: FROM 1-21-75 TO 12-31-75

PROGRAM NO. _____ TITLE (brief): 1975 Energy Conservation Program

STEP	Refer to: **	Resp. *	Due Date	Complet. Date
I. Obtain list of appropriate individuals and establish committee.	Page 4	SJ	2-1-75	
II. Meet with committee and complete action plan for 1975.	P. 4	SJ	2-4-75	
(ACTION PLAN STEPS)				
1. Determine number, date and location of workshops.	P. 4	JS	2-14-75	
2. Contact districts where workshops are to be held for permission and assistance.	P. 4	MC	2-20-75	
3. Prepare energy conservation handbook for dissemination at workshops.	P. 5	JS	3-20-75	
4. Prepare complete plan as to program presentation.	P. 5	SJ	2-14-75	
5. Prepare certificate format for presentation at workshop.	P. 5	JS	2-14-75	
6. Prepare letters to district superintendents with written postcard and mail.	P. 5	SJ	2-20-75	
7. Assign instructors for workshop.	P. 5	SJ	2-14-75	
8. Meet with instructors	P. 5	SJ	2-19-75	
9. Prepare extensive list of energy conservation techniques.	P. 5,8,9	JS	2-14-75	

* See back of this sheet.
** See back of this sheet

STEP	Refer to: **	Resp. *	Due Date	Complet. Date
10. Prepare slides depicting each item on energy conservation list.	P. 6	JS	3-20-75	
11. Prepare presentation demonstrating burner combustion testing.	P. 6	JS	3-20-75	
12. Prepare follow-up by state representatives to districts.	P. 6	SJ	4-1-75	
13. Prepare district reporting procedure to determine degree of success of program.	P. 6	MC	2-20-75	
14. Prepare multi-media use of disseminating energy conservation information.	P. 6			
a) existing state information publications	P. 7	MC	2-14-75	
b) state office energy conservation newsletter.	P. 7	JD	2-14-75	
c) energy conservation video tape training program.	P. 7	JD	4-1-75	
d) public news media.	P. 7	MC	2-14-75	
e) district lectures by state office representatives.	P. 7	SJ	4-1-75	
15. Establish regular meetings of state level energy conservation personnel to revise action plans.	P. 7	SJ	2-14-75	
16. Establish communication chain from state education office to school districts.	P. 7	SJ	2-14-75	

* State office energy conservation personnel (see column "Refer To")

Sam Jones, Director
Jim Smith, Operations Engineer
Jane Doe, Curriculum Director
Sara Smith, Transportation Director
Marie Carol, Secretary

** This column would not appear in the actual action plan format sheet and only applies here to this publication.

EXPLANATIONS OF ACTION PLAN STEPS

(Numbered items refer to same number of action plan steps)

I. In preparing a list of appropriate individuals to be put on the state-level energy conservation committee, great care should be exercised in seeing that individuals are selected who possess real expertise in a particular area of concern. For example: It would be unlikely that a mechanical contractor would be on the committee to offer input concerning mechanical controls or operation of school plant equipment unless he had had a great deal of actual school maintenance and operation experience. More than likely the person possessing the required knowledge would be a school district or state office employee having extensive responsibility in maintenance and operation of school plants. The entire spectrum from management at state level to the custodian should be represented on the committee. The committee should be permanent so that periodic revision of the action plan could be made.

II. The meeting of the committee, when the action plan is to be developed, should be scheduled to take as much time as is needed. This will be the most important meeting of the committee and plans should be developed for the entire program. Time should be considered for possibly performing some research during the period of the meeting. Every conceivable step for the action plan should be carefully considered with the assignment of responsibility being made. Due dates should be selected and the committee will not have been properly selected if every individual does not provide some input.

ACTION PLAN STEPS

(Action plan steps do not necessarily come in chronological order. All step plans are to be conceived, assigned, and scheduled during the "action plan" committee meeting.

1. Number, date, and location of workshops should be very carefully studied by the committee so that the most possible coverage can be obtained. The workshops should be held very early in the year or near the commencing of the program because most action plan steps either relate to the workshops or are tied to instructions given during the workshops. Most states will probably require at least three workshops of at least two-day duration.

ACTION PLAN STEPS (cont'd)

2. Careful planning will pay off in locating workshops and the cooperation of school districts in which conferences are to be located is very important.

3. Handbooks on energy conservation or equivalent come in as very handy tools. Evidence of careful research and sound instructions can be included in loose leaf handbooks. These handbooks should contain table of contents and possibly index. Great emphasis should be placed upon the importance of making use of energy conservation handbooks for the implementation of conservation practices and upon the importance of keeping the handbooks up to date. These reference books can cover the entire spectrum including curriculum, transportation, facilities, and operation.

4. The workshop program plan should be prepared by the entire committee so that every area of energy conservation in education can be considered. Naturally, the workshop program should "dovetail" with the overall energy conservation program.

5. The awarding of certificates to workshop participants will tend to keep them energy-conservation conscious longer than if no attention is given. Such a certificate also provides publicity for the state office and is a reminder to all that the state office is rendering direction in the area of energy conservation.

6. Letters to district superintendents announcing energy conservation workshops and state energy conservation programs should state some background reference to national, state and local involvement in conserving energy.

7. Careful study should be given to the selecting of instructors. District maintenance personnel can easily "see through" on the surface experts. Most district maintenance people already have implemented some energy conservation practices and will expect meaningful instructions at the energy conservation workshops. Handout material that will be included in the handbook and instructions should be directed toward the level of maintenance or management personnel participating in the workshops.

8. A meeting should be scheduled in which all instructors meet with the state workshop supervisors and the workshop program contents should be reviewed very carefully. The entire workshop program format should be discussed and a close look should be taken at the overall action plan. Each instructor should be fully aware of what other instructors are to present. Instructors for a workshop as unique as an energy workshop in which management, maintenance and custodial workers participate simultaneously must be highly diversified in their presentation, but specific in each area.

9. A list of energy conservation ideas should be prepared and become a standard set of techniques for use throughout the period of the program. Obviously, it will be necessary to make revisions from time to time. This list should contain ideas relative to conserving energy in areas of maintenance, minor structure modification and housekeeping. A good time to prepare the list would be during the committee meeting in which the action plan is prepared. The list should serve many purposes including workshop material, state office mail-out material, district handout material at local meetings and news release source of information. The list could be used statewide and become "the standard list of energy conservation ideas for public schools."

10. Slides should be prepared depicting each item on the conservation of energy list. A good time to decide on what pictures would best depict each item would be at the time the original list is prepared by the committee. Experts within the committee would then be available to offer suggestions relative to each conservation idea area. Several copies of these slides should be prepared so that state office representatives could make use of them during lectures requested by school districts and other copies could be made available for loan to school districts implementing conservation programs of their own. Copies of these slides could also be made to the general public but the list of conservation ideas should always be available for handout when slide presentations are made.

11. Combustion testing techniques could be effectively demonstrated in a conference room by use of kerosene camping lanterns to simulate smoke, carbon dioxide, and stack temperature of burners by using standard portable combustion testing laboratory equipment. Since combustion testing is a necessity to achieve maximum combustion efficiency, this demonstration alone would be well worthwhile because it not only teaches workshop participants how to perform combustion tests but it also demonstrates sophistication not normally associated with public school maintenance personnel. Demonstrations of heating and cooling controls can be very effective when typical devices are mounted on demonstration boards if the devices are operable. Such demonstrations keep workshop participants awake, especially if innovative ideas such as flashing lights or ringing bells are likely to come on at intervals. Only personnel proficient in the use of equipment being demonstrated should be permitted to serve as lecturers. Nothing could be more boring than to see a demonstration that does not operate correctly.

12. After workshops have been completed and direction has been given to district personnel, the state office should follow-up by appropriate memoranda and possibly visits. District representatives will have been informed; however, it is easy to return from the workshop, place the written material received on a shelf and forget what happened. A follow-up by the state office will very likely renew interest and possibly bring about action, especially if a visit or telephone call takes place.

13. Some type of meaningful reporting should be required of districts to maintain the energy conservation organization statewide and to supply the state office with enough data so that it could determine further energy conservation effort needed.

14. Unless energy conservation information is disseminated, it is of no value regardless of the quality. No one form of media can do the job because of the importance that every conceivable area of conserving be implemented. Both department of education and other state agencies should be explored in search for a means of selling energy conservation ideas. No other group within state government is in such an ideal position to further energy conservation education to the public as the State Department of Education.

a) State education department publications as well as other state agency publications can be used effectively to publicize the conservation of energy effort.

b) The importance of the energy conservation program could easily justify the emergence of a state office newsletter specifically designed to give state direction to local educational districts in energy conservation matters. As energy conservation efforts occur at the federal level, regulations and general information will be channeled through the state office to local districts. The newsletter could be a convenient vehicle for relaying such material.

c) A carefully planned video-taped training program would serve the state office well in disseminating energy conservation to local districts. A small investment will provide great exposure for maintenance and management personnel of local school districts to state office technical direction in the area of energy conservation.

d) The public news media can be utilized to sell the public, as well as people involved in education, on ways to conserve energy. More than any other state agency the department of education should be in a position to provide the news media with material for its use in bringing to the attention of all not only the importance of energy conservation, but how to conserve energy as well.

e) State education department personnel will be invited by the local school districts and groups such as civic clubs to discuss energy conservation in education. Use of energy conservation ideal lists and slides mentioned earlier will provide lecturers with necessary material without the necessity of extensive research and speech writing. The participation of state department personnel will provide a great amount of importance from throughout the state to the overall state-level program, if question and answer periods are provided at lecture sessions.

15. The national energy program will very likely be changing rapidly, making it necessary for state education policies to be revised frequently. As the need for such revision takes place, the energy conservation committee mentioned in step II should convene to devise additional or alter existing steps of the action plan.

16. Maintenance of good communication between the state office and local school district energy conservation coordinators is a necessity. Information should be channeled both ways through these established communication channels so as to avoid the necessities of going through district superintendents and perhaps ending up with the wrong routing or in wastebaskets. The assumption is made that school districts will have selected an energy conservation coordinator and that communication will have been made between that state office and all department coordinators.

NOTE: Those whose primary interest in facilities should also consult the district level plan in section II together with the checklists and samples of Energy Audit Forms contained in this segment.

ENERGY CONSERVATION

IN

SCHOOL FACILITIES

ENERGY CONSERVATION--NEW SOURCES, SYSTEMS AND TECHNIQUES

The recent energy crisis has stimulated interest in a number of innovative approaches to energy supply and use in educational buildings. Some of these ideas, such as solar, concern new sources of usable energy. Others offer more comprehensive design tools in energy areas, such as computer modeling and life-cycle cost analysis. Still others deal with equipment which operates to control environments more efficiently. Finally, a few represent nothing but a return to some basic principles--principles forgotten in our recent era of energy "abundance."

ENERGY FROM THE SUN

Given a means of efficient utilization, the amount of solar energy falling upon the earth in fifteen minutes would supply man's annual energy needs. Although man has traditionally made indirect use of this energy through food-chains and through the use of vegetable materials for fuel and construction, recent attention has been directed at making direct use of this energy through technological means.

Considerable thought, and more recently, money, has been expended to encourage the development and use of devices which harness solar energy. The principal approaches to this use are (1) the conversion of solar energy to electricity and (2) the collection and use of solar heat.

Of the two, the collection of long-wave heat energy from incident solar radiation and its use to heat and cool buildings is now becoming a proven and productive technique. Although "free" energy costs money, in some areas the cost is already comparable with that of non-renewable fossil fuels. Solar energy enthusiasts have estimated that with currently available technologies, the dependence of buildings on fossil fuels could be reduced 35 per cent by the year 2000 with the appropriate application of solar heat collection systems.

The most commonly available solar heating and cooling systems are based on the flat-plate collector (see Figure 1). Essentially, this system consists of a collector, a heat transfer medium, a storage tank, and pumps to move the transfer fluid. The collector is basically a large plate of dark, heat-conductive material, through, over, or behind which the collection fluid, typically water, glycol, or air, is circulated to pick up the heat absorbed by the plate when exposed to sunlight.

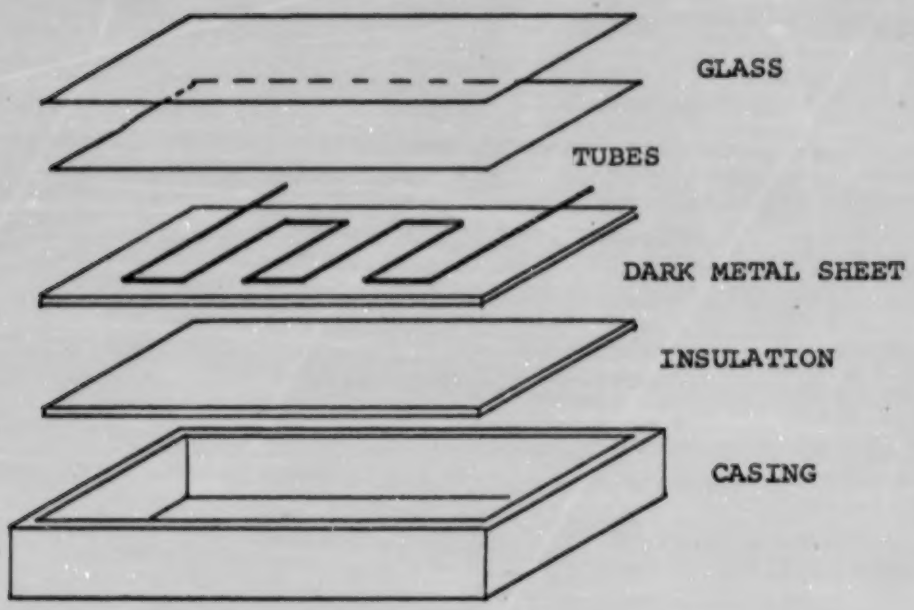


Figure 1

Typical Flat Plate Collector

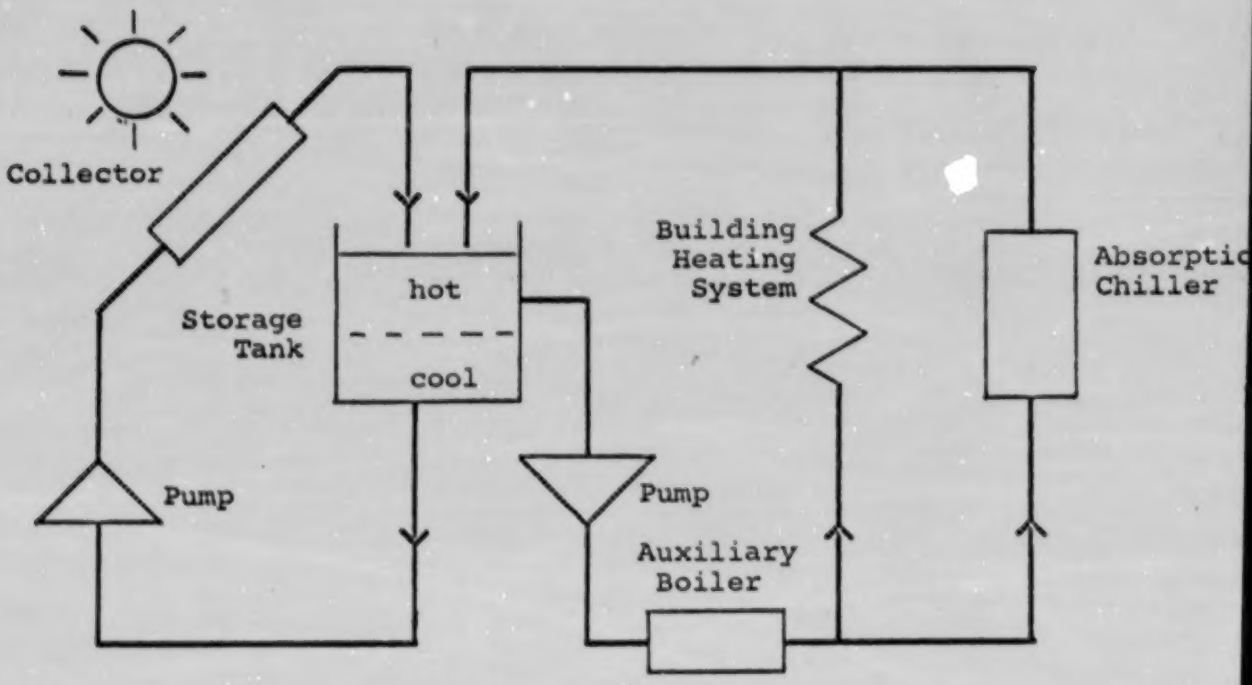


Figure 2

Schematic of Typical Solar Heating/Cooling System

The heated fluid is either used immediately or, if a liquid, stored in a large, insulated tank until needed. If two tanks are used, one for heated and one for chilled fluid, liquid from the cool tank is pumped through the collector at night to give off heat through radiation to the dark night sky. The liquid in the storage tank(s) is then either used directly or in heat exchangers to treat the room delivery medium.

Experience to Date

At the present time, the number of operating solar systems on schools and other large buildings in the United States seems to be growing. There are four school plants converted to solar in Phase 0 of the NSF Solar Energy Utilization program. In these four plants, located in Maryland, Virginia, Minnesota, and Massachusetts, solar systems provide heating for portions of the school building with extensive monitoring of system and plant performance.

A number of other projects are either under construction or design which use solar systems for both heating and cooling, some with federal assistance. The Townes School in Atlanta will have both solar heating and cooling. A 56,000 square-foot museum in Richmond, Virginia will use 28,000 square feet of collectors to provide heated water for its heating and absorption cooling systems. An IECL report is available on a plant under construction in Colorado where solar was coupled with heat pump systems to insure future plant heating and cooling. The largest solar project to date, the 278,000 square-foot Denver Community College North will use 50,000 square feet of collectors for heating and cooling.

The Costs of "Free" Solar Energy

Although input solar radiation is "free," there are some costs associated with its collection and use. In addition to the amortized cost of the solar system collectors themselves currently cost about $10 per square foot installed. The annual "fuel" costs include power to operate liquid-moving pumps and fuel used to heat the plant during long sunless periods. Because of the number of contributory factors, including amounts of sunlight and intensity, costs of competitive fuels and other local conditions, the decision to use a solar system should be subject to detailed analysis.

Although one may not wish to run out and buy a solar system, the Federal Government recommends that all new construction should be designed for the possibility of adding solar in the future. The General Services Administration recommends that, in all new construction:

1. Wall or roof surfaces be oriented to the south for future collector mounting.

2. Hot and cold water storage tanks be sized and space provided for them.

3. Closed loop water-to-air or water-to-water heat pumps and heat recover systems be provided.

4. Space for installation of absorption chillers be provided in the equipment spaces.

For Further Information

"Four Schools Put Solar Heating to the Test." American School and University, (August 1974) pp. 18-21.

Henry, Omer. "Timonium's Solar-Heated School." American Education, (October 1974) pp. 30-33.

Commoner, Barry (ed.). "Solar Energy: Bringing the Sun Down to Earth." Harpers, (June 1974) pp. 3-10 and 101-106.

Daniels, Farrington. Direct Use of the Sun's Energy. New York: Ballantine Books, 1964, 270 pages ($1.95).

Shurcliff, W. A. "Solar Heated Buildings, a Brief Survey." Cambridge, Mass.: W. A. Shurcliff, July 1, 1974, 36 pages (available from Solar Energy Digest, P.O. Box 17776, San Diego, CA 92117, $4.00. This group also publishes a monthly newsletter Solar Energy Digest.

Villecco, Marguerite. "Sun Power." Architecture Plus, (October 1974) pp. 84-99.

1974 Solar Energy Director, ed. Carolyn Pesko. Distributed by Environmental Action of Colorado, University of Colorado, Denver, 1100 14th St., Denver, CO 80202. A comprehensive reference work dealing with all aspects of solar energy. $15.00

LIFE-CYCLE COST ANALYSIS

It has been an unfortunate tradition in the American educational system for school buildings to be constructed on the basis of low first-cost bidding. Although this seems like a good practice to the taxpayer, it often results in buildings that are energy wasteful and that actually squander tax dollars over a period of time. The energy crisis is teaching educators that, to use the words of one facilities expert, "nothing is so expensive as when it is cheap." Life-cycle costing is one method by which school facilities planners are beginning to escape from the temptations of the low first-cost bid.

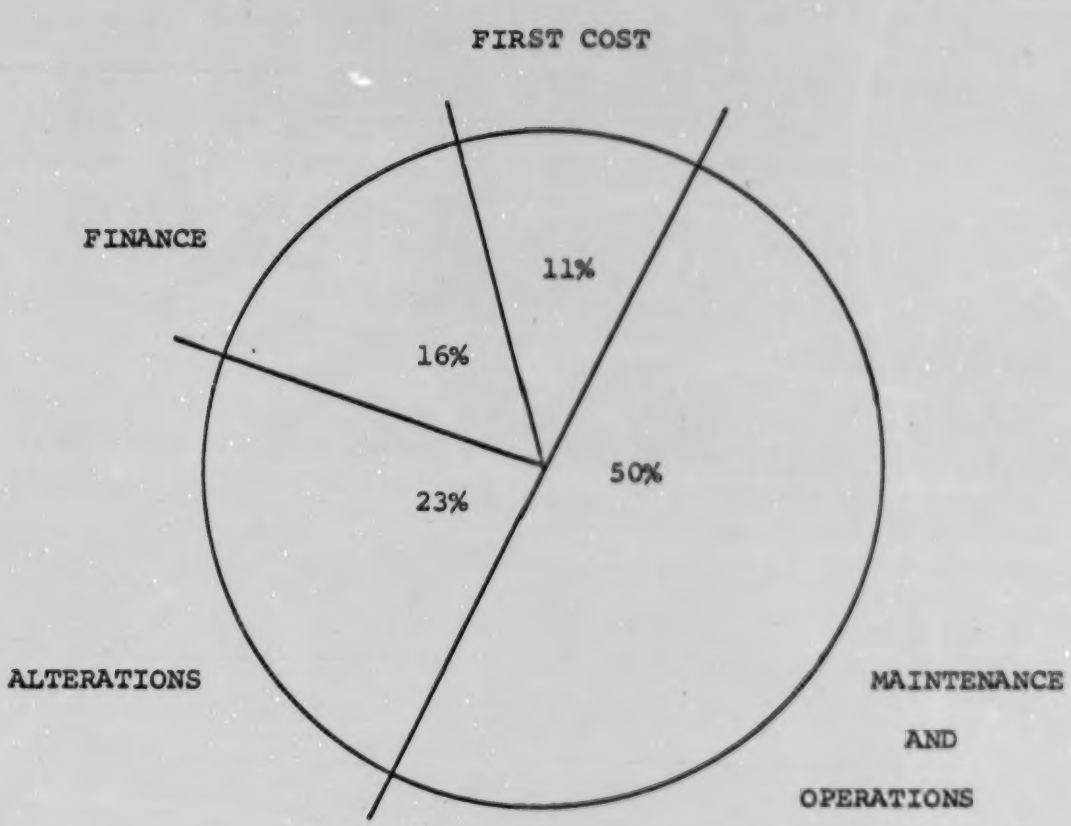


FIGURE 3
Forty-Year Building Costs

Life-cycle cost analysis is a means of estimating, over time, the total costs of owning and operating a system. In the case of a school plant, it combines items from the capital budget with those from the annual operating budgets in a manner not previously possible. How some of these costs relate over a plant's life is shown in Figure 3.

A life-cycle cost analysis requires two cost estimates: one of the capital costs of the building or system and one of the related operating costs. The capital costs of a building are the first costs plus the cost of borrowing the money to pay them. For a school building, the first cost is what appears on the contractor's breakdown while the finance cost is what is paid by the district to buy back the bonds sold to pay for the construction.

Operating costs for a school plant are all the costs of running the building, including fuel and utility costs, minor repair costs, expenditures on required materials and associated salaries. These costs are typically estimated on an annual basis. Operating costs are subject to the effects of inflation, often introducing guesswork into the making of life-cost analyses.

The life-cycle cost analysis is completed by adding the capital and operating cost estimates together on one or more of the following bases:

1. A life-cycle owning cost basis in which the first cost is added to the present worth of the total operating cost over the life-cycle study period.

2. An annual owning cost basis in which the annual capital cost (largely the annual debt retirement) is added to the annual operating cost.

3. Where the result of an added investment is sought, the period required for the annual cost savings to pay off the additional investment, the pay-off period, is often calculated.

If the owner has a thorough knowledge of the factors involved, a life-cycle cost analysis can provide a reasonable estimate of the total cost of a building or system over a given period of time. Alternative solutions may be studied by comparing their life-cycle cost implications. In a similar manner, the outcome of an increased expenditure to reduce operating costs may be analyzed--a very useful tool in modernizing existing plants to improve their energy efficiency.

For Further Information

Educational Facilities Lab. The Economy of Energy Conservation in Educational Facilities. 477 Madison Ave., New York, N.Y. 10022 $2.00

Pehlein, Gary W., Anthony C. Santore, and George P. Zajacek. "Evaluation of Expenditure Alternates." CEFP Journal, October 1973, pp. 4-7.

IMPROVED SYSTEM CONTROLS

One of the major opportunities for energy savings in new or modernized educational facilities comes from the improved controls which may be added to the plant's mechanical system. In general, the more nearly the mechanical system can meet the exact requirements imposed on it, the less wasteful it is in its energy usage. The more flexible and sophisticated the controls of the system, the more likely it will be to fit performance to demand.

Recent improvements and innovations in the technology of system controls permit a finer fit of performance to need. Virtually all of these developments have involved increasing the number of environmental variables the control is able to sense and the number of alternative responses it can dictate.

The logical extreme of this trend has been applied to a high school in Illinois in which the mechanical system is controlled by a time-sharing computer. Taking advantage of a location near a computer center which specializes in remote control of building mechanical systems, the school is tied to the center by leased telephone lines. By monitoring 100 checkpoints in the 2200-student school, the computer is able to precisely control the responses of the HVAC system. For an estimated annual cost of about $14,000, the district is able to save about $28,000 per year in fuel and utility costs, with no capital tied up in computer equipment.

A second trend is toward the use of microcomputers to control systems within the building. Microcomputers are small, relatively inexpensive units with circuitry designed specifically to control mechanical and electrical systems. An example of this type of control is a system introduced recently for the modernization market. This unit is about the size of a small safe. It can turn various building systems on and off to reduce the plant's energy consumption, thereby saving money in demand charges.

Other improvements in controls include simple devices such as improved automatic time clocks for controlling shutdown and setback of mechanical systems and more complex devices such as controls for air-conditioning economizer cycles which sense changes in the moisture as well as the temperature of air.

IMPROVEMENTS IN MECHANICAL SYSTEMS

In addition to the more sophisticated control systems described in a preceding section, other improvements and innovations have been made to mechanical systems which enable them to perform their function better and at lower levels of energy use. The following discussion covers two of these developments--heat recovery and heat pumps.

Heat recovery in a building involves two distinct processes: (1) recovering the heat from the air being exhausted from the building and (2) recovering the heat generated by processes within the building. With the high ventilation rates of most school plants, the heat carried away from the building in exhaust air is a major loss. (This is also the case with the heat contained in ventilation air in the summer.) Currently available equipment, such as heat wheels, heat pipes, and heat pumps, can reclaim up to eighty percent of this heat for pre-heating or pre-cooling intake air.

Motors, lights, and other processes in the building generate a considerable amount of heat which may be reclaimed and used to heat underheated portions of the building or stored. One of the problems with high levels of lighting is that interior zones required cooling most of the year to offset the heat generated by the lamps. Using appropriate fixtures, the heat generated by lights can be collected and moved to exterior or other zones having a heat loss, or stored for use at other times.

The Return of the Heat Pump

During the 1950's a large number of heat pumps were sold and because of the inferior quality of some of the equipment, they received a bad name. In the past few years, greatly improved equipment has become available and this heating and cooling system, which is highly energy-efficient, has once again found wide-spread use.

The heat pump works by reversing the cooling cycle to either add heat to or subtract heat from a space. A mechanical cooling cycle, referred to as a "refrigeration cycle," simply "moves" heat from one place to another by applying the mechanical energy of a group of machines. In refrigeration, this process goes one way, taking the heat out of a space to be cooled and eventually pumping it into the environment. The heat pump improves upon this process by making it reversible, that is, by either moving heat into or out of a place as desired.

There are two types of heat pumps. An air-to-air heat pump transfers heat between two streams of air. The more efficient systems, then, are either water-to-air or water-to-water which make use of water or another liquid as a source or receptor for heat.

Heat pumps may be used to provide direct heating and cooling of a space, or they may be used in connection with heat recovery and/or solar energy systems to step up the relatively low temperatures of the collector fluid to the higher temperatures required by equipment such as absorption chillers.

COMPUTER-ASSISTED BUILDING DESIGN

One of the great advantages of the computer is its ability to handle a vast array of data and calculations. Although it cannot do anything that a person cannot do, it can do any calculation much more quickly and with greater internal accuracy than a human being.

A number of computer program packages are available today which allow the designer to study mathematical models of a building as an energy consumer. The effects in terms of energy consumption and costs of various alternatives of plant, mechanical systems and scheduling can be quickly analyzed with these models.

Advantages of These Systems

Any engineer could perform all the calculations which one of these simulator packages has the computer do. Because of the much greater speed of the machine, however, a great many calculations can be performed, providing the designer with far more comprehensive information about the design than was previously available. Normally these packages can compute the conditions and energy flow within the building for each hour of the entire year.

Two examples illustrate how this comprehensive "output" may be useful to the designer wishing to save energy in a plant design. In the first case, a designer using traditional manual procedures has designed a mechanical system for a building. Running it through one of the computer simulators, he has found that at the coldest hours of the year the indoor temperatures of the building will fluctuate below the desired levels. This situation is shown graphically in Figure 4.

The second example studies the question of a modular design approach to equipment sizing. Equipment operates most efficiently (amount of work produced per unit of energy input) when running at or near its peak load. In Figure 5, the hours of operation of a mechanical system, sized with a single large chiller, is plotted with the part load efficiency of the chiller, using data provided by the computer. The comparison suggests a different selction of chiller size(s).

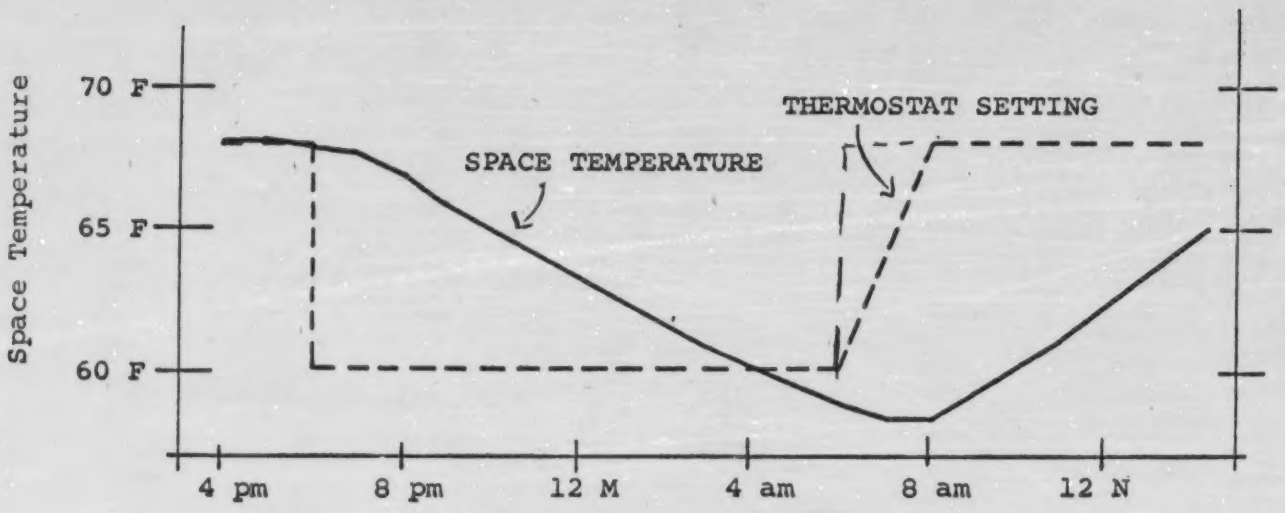


Figure 4

COMPUTER SIMULATION OF ROOM TEMPERATURE

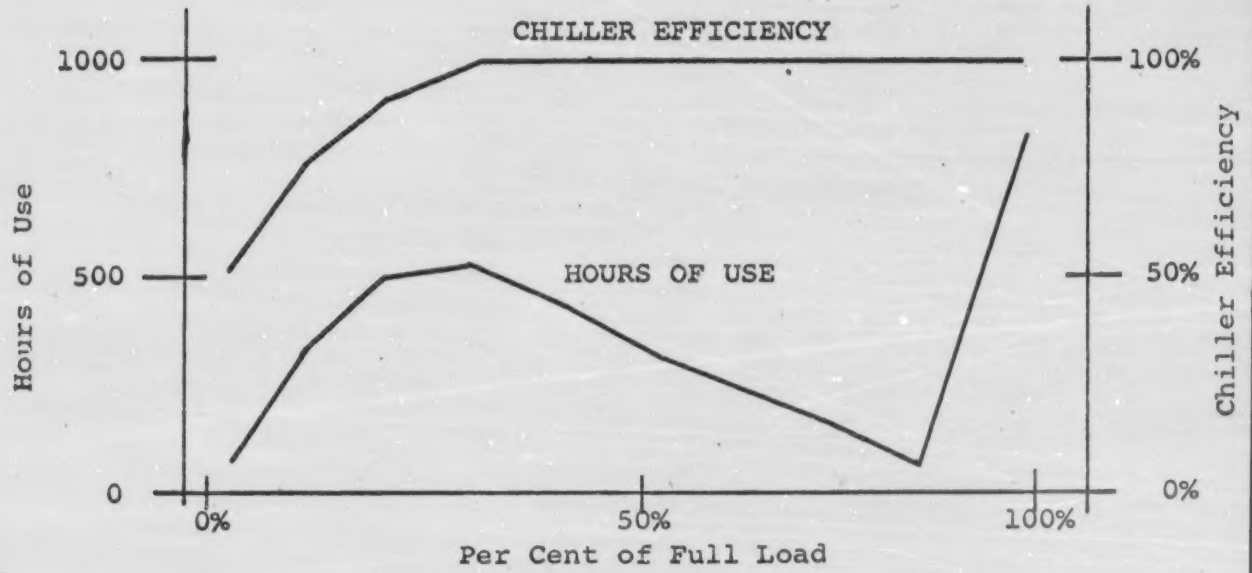


Figure 5

COMPUTER SIMULATION OF CHILLER PERFORMANCE

Problems of Computer Simulators

Although computer simulators can provide more comprehensive data about the energy usage implications of design and operating decisions, there are drawbacks to their use. The major objection is that they can be very expensive. Costs for computer time and for engineering the input can be very high. The preparation of input data and the interpretation of this input require a considerable amount of engineering expertise and experience with the simulator.

For Further Information

Building Systems Information Clearinghouse. Case Studies of Energy Use: Elementary and Secondary Schools. Menlo Park, California; BSIC/EFL, October 1974, 20 pages (available from EFL, 3000 Sand Hill Road, Menlo Park, CA 94025, $2.00 postpaid).

THE REDISCOVERY OF CLIMATE-BASED DESIGN

The ready availability of modern HVAC and lighting systems has, in some respects been a curse in disguise. Assured that these systems could be "plugged into" any sort of building under all kinds of conditions, and unconcerned about the energy-consuming characteristics of these systems, building designers were too often encouraged to build just any kind of building in any kind of location without considering peculiarities of climate, building site, etc. The energy crisis alerted us to the danger of this practice and provided a sobering awakening; energy was no longer freely available and cheap, and the consequences of inappropriate designs began to be felt. Considerable research is now underway to develop and rediscover building forms and elements which will reduce dependence upon artificial methods of environmental control.

The recognition of climate and natural means of environmental control is not an innovation. Before the blessings of the technical revolution, man had evolved forms which were at or near equilibrium with a variety of climates. Of course, these forms are not always appropriate for the type of activities and life-styles of today's schools. (It is nearly impossible to build an igloo large enough to house large group instruction.) Still, the experience of the past should form part of the skills of designers and does have application today.

For each climate, building location, and educational program and philosophy, it is possible to design an effective and pleasant plant which is suited to the types of conditions which will be encountered. With such a plant, reliance on aritificial environmental conditioning may be minimized. One expert has estimated that up to sixty percent of the cost of equipment and energy required to heat and cool a simple building may be saved in most climatic zones with appropriate design.

ENERGY CONSERVATION
IN THE
SCHOOL CURRICULUM

"The Energy Crisis can be the most effective teaching aid of the decade."

S. David Freeman

INTRODUCTION

If the "energy crisis" is interpreted broadly as a mixture of the three "E's"--Energy, Economics, and Environment--then the crisis is still with us and will continue to trouble us for the next decade, and possibly the next two decades. It is important therefore that several generations of students be prepared to deal with it and to form the new society that will emergy beyond the crisis.

What follows is a general introduction to some of the problems faced by educators in attempting to make a place for energy concerns within the school curriculum. These ideas are, in part, a product of energy conservation workshops in curriculum conducted during four IECL conferences.

THE THREE "E's" IN THE CURRICULUM: STYLES AND PRIORITIES

There seem to be three main methods of introducing the three "E's" into the curriculum. These will be discussed under the headings of Awareness, Missions, and Integration.

Awareness

It is natural that the first impact of energy or any other new theme is on citizen awareness. Drugs, or racial tensions, hit the front pages and students want to talk about them. The long lines of irritated motorists waiting for gas brought the energy crisis into the classroom. Students wanted to know what was happening and teachers wanted to tell them and to vent their own frustrations or air their own solutions.

Awareness is a proper educational goal. Students should know what is happening in their world and education should select and illuminate current problems. But awareness is related to media attention. When the gas lines disappear, when the newspapers and television look away, so do students and teachers. Once the alarm has been rung, the dire warnings given and the disasters predicted, it is hard to gain attention in the same way again. The deeper problems may remain, but students demand more than simply to be told about these problems; they want to find out how to do something about them.

Mission

With awareness often comes mission orientation. Drug education for instance is mission-oriented toward reducing or eliminating drug usage. The obvious mission in the energy area is the one we are now involved in: energy conservation.

It is obvious that a necessary component of almost any overall strategy aimed at reducing the tension among the three "E's" is the reduction in consumption. It is also obvious and natural for those who pilot these strategies to want to get their message loudly and clearly into the classroom. Students are valuable allies. Not only are their own life styles and habits of consumption open to influence but their parents and others in the adult population can often be reached through them.

It is exactly because of this that mission-oriented education is potentially dangerous and should be entered upon only with great caution and under careful surveillance. The schools are so potentially effective as a propaganda arm that they must be protected. Our system is deliberately designed to provide that protection.

Energy conservation is so obviously beneficial that it appears safe to relax our vigilance against propaganda and allow the various messages to come through. "Turn down the thermostats; turn off the lights; bus more and drive less." No harm can come from these prescriptions. But mission-oriented education, however worthy its goals, remains alien to the most important purposes of American education. Educators do not want to teach the students what to do in the situations which do and will confront them. Rather they want to teach them sound strategies of analysis and decision-making so that they can, themselves, decide what to do.

The spectrum of issues to be faced in the next two or three decades is too broad for anyone to anticipate the proper targets. It is only by becoming components of the basic thrust of all teaching that energy economics and environment will make their strongest and most lasting contribution to curricula.

Integration

There are two different ways in which a group of ideas, facts, and concepts, such as those included in the three "E's," can impact the curriculum. They can appear as new courses or curricula following the examples from the 1960's when PSSC, BSCS, Them Studies, the High School Geography Project, etc. were designed and implemented. There is a place for a course on the three "E's" in many schools and the design of three such courses would provide worthy funding projects and exciting challenges.

The curriculum is too crowded, however, and there are too many other worthy subject areas (career education, black studies, drug education, sex education, etc.) for a new course to make much impact. There will be schools which can afford a variety of courses and students with enough time, talent, and interest for a course on Energy, Economics, and the Environment (or some such title) but the bulk of the student body will not be reached in this way.

To achieve maximum impact, the themes embodied in the three "E's" must pervade the existing system. These themes must find natural employment in the satisfaction of basic learning goals. In achieving this integration into the existing curricula, they will be greatly assisted by the fact that the themes themselves are basic.

THE THREE "E's" AS INTEGRATED CURRICULAR COMPONENTS

The long-term urgency associated with the interconnected problems of the three "E's" along with the basic nature of the concepts involved,

make it essential and efficient that these concepts, ideas, and facts be integrated into the K-12 Curriculum. Integration is the operative word because for the most part, the ideas must become vehicles for existing learning goals rather than separate goals in themselves. This prescription can be illustrated with the following examples:

There is a period in most 2nd or 3rd grade classes when the focus is on the structure of the local community. This activity provides an excellent opportunity for children to examine the community's transportation system. Students cannot only describe where people go and how they get there; they can also estimate the energy cost of existing and alternative methods of getting people to their destination.

The three "E's" can also be integrated into teaching units designed to explore the structure of their community and its relationship with the world outside. Students can investigate the forms and local sources of energy in their local areas and then go beyond the local community to consider ultimate sources of energy; the methods and effects of its production, extraction, and transportation. A further understanding of the three "E's" can be developed by looking at jobs that are directly or indirectly related to energy.

Further along in the K-12 sequence, one may take advantage of geography lessons. If the world as a whole is the target, then, as they contrast regions and cultures they should also contrast energy resources and energy consumption. Energy trade becomes yet another of the global linkages which deserve emphasis.

In another class there will be a unit on the Middle East. Here a teacher should consider the treatment of the subject incomplete if it doesnot involve discussion of energy resources, energy dependency, etc. How much oil is there, where is it sold, what effect is it having on the local population, how does it influence their national and international politics, etc.?

This focus on the Middle Eastern oil picture in a geography class could be paralleled with complimentary themes in other classes for those same students. In a physical science class they could study the molecules of oil and natural gas as well as the chemistry involved in cracking and refining crude oil to gasoline or in using petrochemicals to make plastics. In an earth science class, a unit on oil exploration would allow much learning to take place and there, or in a biology class, the formation of oil from once-living material would be worthy of study. In a social studies class the international politics of oil, in particular the Arab-

Israeli impasse, would grow from the same theme. In an English class a group of ads from oil companies and conservation groups could be used for practical work in critical thinking. Finally, one could focus all of the students' attention, for a week or so, on related issues from some part of the three "E's" picture and by doing so make those important points, not only about the complex nature of real problems, but also about the utility of the separate academic disciplines in dealing with such problems. Admittedly this kind of educational experience is rare.

There are, of course, a host of similar examples that could be given in support of the integration of the three "E's" but these two or three, at least, make the point that it could happen.

PROBLEMS IN ENERGY CURRICULUM DEVELOPMENT: THE CONTRIBUTION OF IECL WORKSHOPS

Lessons for Future Developers

From workshop discussions, source guidelines and suggestions of future needs were gathered. The obvious desirability of the involvement of teachers and students at all stages of development was underscored.

Also stressed was the importance of a technical review for produced materials. Obtaining such a review is no easy matter. Both the breadth of the subject matter including physics, chemistry, biology, geology, engineering, economics, political science, ethics and philosophy, and the existence of different points of view (on nuclear power, for instance) make it imperative that a diverse technical review be provided. The existence of different viewpoints is one of the educationally important features and it is important, therefore, to present controversy fully rather than to hide it in blandness and brevity.

It is a further strength of energy education, and indeed of environmental education, that it is inescapably multidisciplinary and problem-oriented. For this reason it should be taught through styles and strategies which are not wholly presentational. Team teaching, role playing, student and class projects are particulary appropriate pedagogical techniques.

The Problem of Curricular Variety

A weakness of present energy education is that it has most often been directed at a small elite group of students, largely those in the sciences. In the IECL workshops it was suggested that further variety

would be desirable in the high schools. Integration of energy themes, in particular, themes which provide stimulus and suggestions for energy conservation, should be accomplished in all curricula. This integration would be equally appropriate in vocational curricula, driver education, home economics, career education, etc.

Several workshops also reminded us that adult education is an important function of state school systems and recommended that special courses featuring both reasons and strategies for energy conservation be developed for adult consumption.

Other Avenues of Change

Several other important methods of bringing the three "E's" usefully into the school curriculum were given attention in the workshops. It was pointed out by several participants that the teacher-training institutions are important in any strategy to accomplish integration of energy themes into the curriculum. There was considerable discussion of possible ways to influence the development of "methods courses" in the sciences and social studies areas which would deal with energy-related topics and examples. It was generally agreed that although one could expect some leadership from education facilities and text book authors, the major movement would probably be from the bottom up, and that the teachers themselves should remain the primary target of any energy education campaign.

Another route for energy ideas is provided by television. This medium is, of course, the most effective as far as exposure is concerned and therefore is already playing some role in general energy conservation education. Two other uses of educational TV were also put forward. As teacher interest in energy topics develops there will be concepts--some of those from nuclear energy, for instance--which will be (chiefly for technical reasons) difficult for teachers to handle. Some of these could be presented via TV. TV can also be important in the training workshops which will be needed if energy/environment ideas and teaching techniques are to become a part of the general teacher repertoire.

SUMMARY

Workshop participants at all four IECL conferences were united in their belief that energy-related themes were both appropriate for and urgently needed in the educational curriculum. While these related ideas could properly, at the high school level, form the basis for a full course, it was generally agreed that more students would be reached most effectively if the themes were integrated into present curricula.

In order for this to happen a variety of conditions must be met: Educational Administrators from the Chief State School Officer to the local principal must be convinced of the importance and appropriateness of the subject. Useful material which is technically correct, unbiased, and student-oriented must exist. Teachers must not only be made aware of the materials but motivated and prepared through local workshops for their use.

The job of materials preparation is begun and some of the early results are listed in this report. (See curriculum segment in section II.) It is hoped that similar developments will accumulate rapidly and that many activities will be contributed by classroom teachers.

ENERGY CONSERVATION CONTACTS BY STATE AS COMPILED BY IECL AT REGIONAL CONFERENCES

CONTACTS LIST

ARKANSAS

Teeter, Joe Supervisor of Internal Administration	Arkansas Department of Education State Education Bldg. Little Rock, AR 72207	

CALIFORNIA

Boice, John R. Director	Educational Facilities Laboratories, Inc. 3000 Sand Hill Road Menlo Park, CA 94025	
Burns, Joshua A. Assoc. Project Director	Educational Facilities Laboratories, Inc. 3000 Sand Hill Road Menlo Park, CA 94025	(415) 854-2300
Ono, George Electrical Engineer	U.S. Department of Health, Education & Welfare 50 Fulton St., Rm. 144 San Francisco, CA 94102	

CANADA

Boesener, Peter J. Supervisor Maintenance Engineering	The Peel Board of Education 90 Dundas Street West Mississauga, Ontario L5B1H5	(416) 279-6010 Ext. 254

COLORADO

Anderson, Dr. Calvin E. Executive Director Supporting Services Unit	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-2214
Atkinson, Lawrence Project Architect	More Combs Burch 3911 E. Exposition Ave. Denver, CO 80209	(303) 744-3157
Bollman, Henry E. Regional Director	Brick Institute of America 9841 Lunceford Lane Denver, CO 80221	(303) 455-4791
Bracken, Roy Operations Div.	Federal Energy Administration P.O. Box 26247, Belmar Branch Denver, CO 80226	(303) 234-2596
Britton, Clarence O. Director, Plant & Auxiliary Services	Boulder Valley School District Box 11 Boulder, CO 80302	(303) 447-1010 Ext. 223

COLORADO (cont'd)

Britton, Dr. Russell Regional Energy Coordinator	Office of Education Federal Office Building 1961 Stout St. Denver, CO 80202	(303) 837-4295
Browne, E. J. Manager, Marketing Projects	Public Service Company 550 15th St. Denver, CO 80202	(303) 571-7421
Casebeer, Richard S.	Northern Colorado Board of Cooperative Services 830 S. Lincoln Longmont, CO 80501	(303) 772-4420
Craig, Calvin Director, Physical Plant, Transportation	School District 20 USAF Academy, CO 80840	(303) 472-1733
Davis, Helen R. Coordinator of Elementary Education	Arapahoe County School District Six 6558 So. Acoma St. Littleton, CO 80120	(303) 798-2501
Duncan, Dr. Roger L. Director, Development & Demonstration Svcs.	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-2486
Ek, George Consultant, Development & Demonstration Svcs.	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-3382
Faver, General Dudley Regional Administrator	Federal Energy Administration, Region VIII P.O. Box 26247, Belmar Branch Lakewood, CO 80226	(303) 234-2420
Flint, Richard J. Principal	School District #12 10280 N. Huron Denver, CO 80221	(303) 451-1561
Frazier, Dr. Calvin M. Commissioner	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-2212
Garrett, Dr. Polly	Federal Energy Administration Region VIII P.O. Box 26247, Belmar Branch Lakewood, CO 80226	(303) 234-2596
Gassert, Dr. W. M. Associate Professor	Metropolitan State College Industrial Education Department 250 W. 14th Ave. Denver, CO 80204	(303) 292-5190

COLORADO (cont'd)

Goorian, Philip Reports & Analysis Div.	Federal Energy Administration P.O. Box 26247, Belmar Branch Lakewood, CO 80226	(303) 234-4596
Hickel, Edwin G. Environmental Studies Teacher	Westminster High School 6847 Clark Ct. Denver, CO 80221	(303) 429-7629
Johnston, Mrs. Robin Vice Chairman	Colorado Board of Education 201 E. Colfax Ave. Denver,, CO 80203	(303) 892-2212
Kirby, Keith E. Teacher	Denver Public Schools 5207 E. Exposition #102 Denver, CO 80222	(303) 388-0720
Kryger, Dr. King C. Assistant Project Director, IECL	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-2214
Landry, Leonard Grants Director	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-3081
Leftwich, Stanley A. Assistant Commissioner	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-2262
Livingston, L. L. Director, Special Services	Delta County School District #50 RFD 1, Box 127 Delta, CO 81416	(303) 874-4438
Martin, Gene B. Vice President	Energy Management Consultants, Inc. 228 N. Cascade, Suite 101 Colorado Springs, CO 80902	(303) 473-177
Meadows, Ms. Betty Jane Resource Specialist	Jefferson County School District 1209 Quail St. Lakewood, CO 80215	(303) 279-3346
McCabe, Mike Asst. Legislative Aide to Senator Gary Hart	1400 E. 18th Ave. Denver, CO 80218	
Montgomery, Dr. Donald Assoc. Professor	Department of Educational Administration University of Northern Colorado Greeley, CO 80631	(303) 351-2861
Moore, Thomas E. Regional Engineer	U.S. Dept. of HEW Region VIII 11037 Federal Bldg. Denver, CO 80202	

COLORADO (cont'd)

Pollard, Ms. Marilyn Publications Coordinator	Public Service Company of Colorado P.O. Box 840 Denver, CO 80202	(303) 255-1725
Pottorf, Mrs. Coila Documents Librarian	Colorado State Library 1362 Lincoln Denver, CO 80203	(303) 892-2171
Reckard, Dale Asst. Superintendent Physical Plant, Food Svcs.	Keenesburg School District RE-3 P.O. Box A Keenesburg, CO 80643	(303) 732-4844
Reibold, Ms. Mary J. Teacher representative on energy conservation	Jefferson County Schools 6626 W. 79th Ave. Arvada, CO 80003	(303) 986-1586
Paul, Richard Teacher on special assignment--science	Cherry Creek School District West Middle School 5151 So. Holly Littleton, CO 80210	(303) 771-3112
Rosol, Bill	Rocky Mountain Electrical League 550 15th St., Rm. 1158 Denver, CO 80202	(303) 255-1725
Ross, Mrs. Doris M. Research Associate	Education Commission of the States Lincoln Tower Bldg., Rm. 300 1860 Lincoln St. Denver, CO 80203	(303) 893-5200
Severson, Gary J. Environmental Education Officer	U.S. Forest Service P.O. Box 25127 Lakewood, CO 80225	(303) 234-4185
Smith, Howard S. Engineering Consultant	Public Service Company 550 15th St. Denver, CO 80202	(303) 571-7302
Tyler, Scott Public Affairs Officer	Federal Energy Administration P.O. Box 26247, Belmar Branch Lakewood, CO 80226	(303) 234-2420
Wine, Ron Assistant Director	Colorado Association of School Boards 1330 Logan St. Denver, CO 80203	(303) 832-6691
Williams, Dr. Dave Regional Field Coordinator	Colorado Department of Education 201 E. Colfax Ave. Denver, CO 80203	(303) 892-2222

CONNECTICUT

McKenna, John P. Coordinator, Construction and Maintenance	State Department of Education 165 Capital Ave. Hartford, CT 06106	(203) 566-5279
Whritner, Dr. John A. Superintendent	East Lyme Public Schools East Lyme, CT 06333	(203) 739-8561

DELAWARE

Nichols, Dr. Jack Supervisor School Plant Planning	Department of Public Instruction Delaware Department of Education Townsend Building Dover, DE 19901	

DISTRICT OF COLUMBIA

Baird, Dr. John	Division of Adult Education Department of HEW Regional Office Bldg., Rm. 5076 7th & D Sts. SW Washington, DC 20202	(202) 245-9782
Bakke, Dennis W. Deputy Assistant Administrator	Office of Conservation and Environment 6448 Federal Bldg. 12th & Penna. Ave. NW Washington, DC 20508	
Blubaugh, E. David Industrial Engineer	Office of the Secretary Office of Facilities Engineering and Property Management Division of Plant Management 330 Independence Ave. Washington, DC 20003	
Bogan, Walter Director of the Division of Educational Technology and Environmental Education	Office of Education 400 Maryland Ave. SW Washington, DC 20202	(202) 245-9231
Cameron, Dr. John Director	Educational Broadcasting Facilities USOE 400 Maryland Ave. SW Washington, DC 20202	
Coggeshall, Ken Public Affairs Officer	Office of Education U.S. Department of HEW Office of Public Affairs, Rm. 4171 400 Maryland Ave. SW Washington, DC 20202	(202) 245-8557

DISTRICT OF COLUMBIA (cont'd)

Duggan, Donald Director, Educational Programs	Energy Conservation & Environment Federal Energy Administration Washington, DC 20461	(202) 961-7566
Fowler, Dr. John Project Director Energy-Environment Materials Project	National Science Teachers Assn. 1742 Connecticut Ave. NW Washington, DC 20009	(202) 265-4150
Kimmel, Ms. Alice	Community Relations/Public Education Old Post Office Bldg., Rm. 307 12th & Penna NW Washington, DC 20461	
Matthews, Dr. Howard Assistant to the Commissioner	Office of the Commissioner U.S. Office of Education, Rm. 4177A 400 Maryland Ave. SW Washington, DC 20202	(202) 245-9834
Nicklin, Richard F.	U.S. Office of Education HEW Washington, DC 20202	
Osso, Nicholas Educational Specialist	Division of Survey Plans and Operations National Center of Educational Statistics 400 Maryland Ave. SW Washington, DC 20202	(202) 245-8153
Robinson, Miss Marie Public Information Specialist	Office of Public Affairs, Rm. 2098 U.S. Office of Education 400 Maryland Ave. SW Washington, DC 20202	(202) 245-8557
Rogers, Patricia	Public Affairs/Community Relations Federal Energy Administration Washington, DC 20461	(202) 964-3816
Stephan, Edward	Office of Energy Conservation & Environment Federal Energy Administration, Rm. 6439 12th & Penna. Ave. NW Washington, DC 20461	(202) 961-8282
Svenson, Dr. Erik	Office of Energy Conservation and Environment Federal Energy Administration 12th & Penna Ave. NW Washington, DC 20461	(202) 961-8371
Thomas, Robert	Bureau of School Systems Division of State Assistance U.S. Office of Education, Rm. 3010 (ROB) 400 Maryland Ave. SW Washington, DC 20202	(202) 245-2695

FLORIDA

Viles, Nelson E. Administrator, School Plant Management	Florida Department of Education Tallahassee, FL 32304

GEORGIA

Brantley, Walter	Georgia Department of Education School Plant Services, Rm. 101 156 Trinity Ave., SW Atlanta, GA 30303
Bridges, Robert W. Conservation Specialist	Federal Energy Administration 1655 Peachtree St., NE Atlanta, GA 30309
Goatcher, R. N.	Phillips Petroleum Company 2220 Parklake Drive, NE Atlanta, GA 30302
Griffin, Earl E.	Division of Business Services office of Staff Services Georgia Department of Education Rm. 237, State Office Building Atlanta, GA 30334
Lloyd, John H. Associate State Director	Georgia Department of Education 340 State Office Building Atlanta, GA 30334
Sayre, Philip P. DHEW Regional Policy & Conservation Coordinator	DHEW - Region IV - Rm. 521 50 Seventh St., NE Atlanta, GA 30323
Stelson, Dr. Thomas E. Vice President for Research	Georgia Institute of Technology 225 North Ave. Atlanta, GA 30332
Wills, Paul Director, Ancillary Service Div.	Georgia Department of Education 156 Trinity Ave. SW Annex Room 216 Atlanta, GA 30303

IDAHO

Montgomery, Martin	Idaho Office of Energy Governor's Office of Energy Boise, Idaho
Page, Elden R. Clerk of the Works	School District #25 3115 Pole Line Rd. Pocatello, ID 83201

ILLINOIS

Barclay, William O., P.E.	U.S. DHEW-ROFEC, Rm. 3300 300 So. Wacker Chicago, IL 60606	
Faber, Ed Energy Coordinator	USOE, Region V 300 So. Wacker Drive Chicago, IL 60016	(312) 353-5146
Kakela, Dr. Peter Assistant Professor	Sangamon State University Environments and People Program Springfield, IL 62708	
Sampson, Dr. J. Robert Assistant Director Instructional Services	Office of the Superintendent of Public Instruction 316 So. 2nd St. Springfield, IL 62706	(217) 782-2826

INDIANA

Sharp, Dr. Charles L.	Indiana Department of Public Instruction Rm. 227, State House Indianapolis, IN 46204	

IOWA

Tymeson, John Emergency Services Officer	Iowa Civil Defense Division Energy Office Robert Lucas Building, Rm. B-33 Des Moines, IA 50319	

KENTUCKY

Dowler, Thomas E. Supervisor	Division of Buildings and Grounds Kentucky State Department of Education Fountain Place Frankfort, KY 40601	
Pollock, Samuel Unit Director	Division of Buildings and Grounds Kentucky State Department of Education Capital Plaza Frankfort, KY 40601	

LOUISIANA

Friloux, James J. Federal/State Liaison Officer	Federal Energy Administration Suite 545, Commerce Building 333 Laurel St. Baton Rouge, LA 20801	
Hudson, Carlton V., Assistant Chief	Division of Natural Resources and Energy P.O. Box 44156, Capitol Station Baton Rouge, LA 70804	

MAINE

DiCara, Vincent Emergency Energy Coordinator	Fuel Allocation and Conservation Office State Office Building Augusta, ME 04330	(207) 622-6201 Ext. 317

MARYLAND

Freeman, S. David Special Consultant, Senate Commerce Committee	7111 Pyle Road Bethesda, MD 20034	(202) 224-9354
Johns, John A. Specialist	Emergency Preparedness Education Maryland Department of Education P.O. Box 8717 Baltimore-Washington International Airport Baltimore, MD 21240	

MASSACHUSETTS

Anderson, Eric R. Senior Program Officer	U.S. Office of Education JFK Federal Bldg., Room 2303 Boston, MA 02203	
Brayman, Sumner M. Program Officer	Higher Education Facilities U.S. Office of Education JFK Federal Bldg. Boston, MA 02203	
Catacchio, Vincent A. Associate Dean	Career Education Middlesex Community College Springs Road Bedford, MA 01730	(617) 275-8910 Ext. 234
Cavicchi, Alton Executive Director	Massachusetts Association of School Committees 73 Tremont St. Boston, MA 02108	(617) 523-1250
Eastman, Carl W. Executive Director	School Bus Contractors Association of Massachusetts 73 Tremont St., Rm. 425 Boston, MA 02108	(617) 227-2039
Finegan, Edward T. Conservation Specialist	Federal Energy Administration 150 Causeway St. Boston, MA 02114	(617) 223-3716
Logan, William Jr.	Regional Commission of Education DHEW-Office of Education JFK Federal Building Government Center Boston, MA 02203	

MASSACHUSETTS (cont'd)

McCann, Richard	USOE, Room 2303 JFK Bldg. - Government Center Boston, MA 02203	(617) 223-4558
Mitchell, Robert Regional Administrator	Federal Energy Administration - Region I 150 Causeway St. Boston, MA 02114	
Mulhern, Charles Supervisor, Vehicle Inspection	(617) 727-4517 Massachusetts Registry of Motor Vehicles 160 N. Washington St. Boston, MA 02114	
Oser, James Energy Policy Advisor	Massachusetts Senate Special Energy Commission 13 West Newton St. Boston, MA 02118	(617) 536-6010
Philpott, Robert T. Director	Conservation and Energy Resource Div. Federal Energy Administration - Region I 150 Causeway St. Boston, MA 02114	(617) 223-5884
Rogers, Mrs. Carolyn Senior Supervisor	Pupil Transportation Department of Education 182 Tremont St. Boston, MA 02111	(617) 727-8477
Sullivan, James Regional Engineer	Region I - Facilities Engineering and Construction DHEW - 13th floor JFK Building Boston, MA 02203	(617) 223-6641
Towey, Dr. Carroll	USOE JFK Building - Government Center Boston, MA 02203	
Turo, Leo P. Director	Bureau of Management Services Department of Education 182 Tremont St. Boston, MA 02111	(617) 727-5790
Unda, Walter Sr. Vice President	School Bus Contractors Association Rm. 425 73 Tremont St. Boston, MA 02108	(617) 227-2039

MASSACHUSETTS (cont'd)

Vanderweil, Gary President	R.G. Vanderweil Engineers, Inc. 99 Bedford St. Boston, MA 02111	(617) 423-7423
Welch, Roger J. Board Member	School Bus Contractors Association Room 425 73 Tremont St. Boston, MA 02108	(617) 227-2039

MINNEAPOLIS

Christiansen, Fredrik Director	Facilities Planning & Operations Minnesota Department of Education 505 Capitol Square Bldg. 550 Cedar St. St. Paul, MN 55101	(612) 296-2288

MISSOURI

Gray, Harry Mechanical Engineer	DHEW-ROFEC 601 E. 12th St. Kansas City, MO 64106	
Syng, Victor J. Director of Energy Conservation	Federal Energy Administration Region VII 112 East 12th St. Kansas City, MO 64106	(816) 374-3815
Tumy, James B. Regional Program Officer	Office of Education , DHEW 601 E. 12th St. Kansas City, MO 64106	

MONTANA

Regan, Dan	Montana Power Company 40 E. Broadway Butte, MT 68722	

NEBRASKA

Sughrove, Gerald Energy Conservation Coordinator	Nebraska Department of Education 233 So. 10th St. Lincoln, NB 68508	(402) 471-2452

NEVADA

Burk, Vernon H. Director, Maintenance and Operation	Clark County School District P.O. Box 551 Las Vegas, NV 89121	
Meizel, Michael Manager Assistant	State of Nevada, Department of General Service Blaydel Bldg. Corner of Fall & Musser Carson City, NV 89701	

63

NEW JERSEY

Colavita, Leon Director	Bureau of Emergency Preparedness Education New Jersey Department of Education 3535 Quakerbridge Rd. Trenton, NJ 08619	(609) 292-4374
McChesney, Warren E. Supervisor Buildings and Grounds	East Windsor Regional School District 384 Stockton St. Hightstown, NJ 08520	
Snyder, Paul Assistant Superintendent	East Windsor Regional School District 384 Stockton St. Hightstown, NJ 08520	(609) 448-4622

NEW HAMPSHIRE

Stahl, Ms. Judy	Governor's Council on Energy 3 Capitol St. Concord, NH 03301	(603) 271-2711
Tate, Gordon R. Assistant Chief	Division of Administrative Services State Department of Education State House Annex, Rm. 410 Concord, NW 03301	(603) 271-3620

NEW YORK

Baltzel, C. Stanton Assistant Director	Education Facilities Planning New York State Education Department 99 Washington Ave., Rm. 1713 Albany, NY 12230	(518) 474-3906
Crouch, C. L. Director of Research	Illuminating Engineering Research Institute 345 E. 47th St. New York, NY 10017	(212) 752-6800 Ext. 270
Edwards, John S. Deputy Director	Emergency Fuel Office Tower Building Empire State Plaza Albany, NY 12223	(518) 474-7927
Faust, Herbert Superintendent Buildings and Grounds	Middle Island Central School District 12 P.O. Box 131 Haphank, NY 11980	(516) 924-7400 Ext. 75
Hess, Fritz Superintendent	East Syracuse - MINOA Central Schools Administration Bldg. East Syracuse, NY 13057	(315) 656-7201

NEW YORK (cont'd)

James, Arthur Supervisor	New York State Education Dept. Rm. 1711 Twin Towers Albany, NY 12230	(518) 474-3911
Miller, Robert M. Senior Architect	Educational Facilities Planning New York State Education Dept. 99 Washington Ave. Rm. 1713 Albany, NY 12230	(518) 474-6473
Richter, Rudolph G. Project Engineer Energy Programs Group	Energy Conservation Systems Grumman Aerospace Corp. Bethpage, NY 11714	
Smith, Ms. Eleanor Senior Program Officer	USOE - Region II Rm. 3950 26 Federal Plaza New York, NY 10007	(212) 204-4417
Trentacosti, Frank Regional Engineer	HEW - Region II 26 Federal Plaza New York, NY 10007	

NORTH CAROLINA

Albano, Phil Director of Facility Planning	Division of Institutional Services Department of Community Colleges Raleigh, NC 27611	
Alexander, Louis W. Assistant Director	Division of Transportation State Board of Education Rm. 132, Education Bldg. Raleigh, NC 27611	
Barker, Moses L., Jr.	State of North Carolina Purchase and Contract Division 116 W. Jones St. Raleigh, NC 27611	
Bisesi, Philip J., P.E. Consulting Engineer	Affiliated Consultants Engineers 915 Winterlochen Drive Greensboro, NC 27410	
Brown, Clinton L. Consultant	Division of Science Education N.C. Department of Public Instructions Rm. 284, Education Bldg. Raleigh, NC 27611	
Bordeaux, J.	Department of Human Resources 325 Salisbury St. Raleigh, NC 27611	

NORTH CAROLINA (cont'd)

Carruth, James W. Director	Division of Educational Media North Carolina State Department of Public Instructions Raleigh, NC 27611	
Cause, Ms. Sue	North Carolina Department of Public Instructions Public Information and Publications Raleigh, NC 27611	
Culbreth, Doug	Energy Division 215 E. Lane St. Raleigh, NC 27611	
Dark, Delphos, J. Director	State Board of Education Division of Transportation Rm. 132, Education Bldg. Raleigh, NC 27611	
Davis, A. C.	State Board of Education Rm. 306 Education Bldg. Raleigh, NC 27611	
Denning, Carsie K., P.E. Director	Division of Plant Operation Office of Superintendent of Public Instruction Rm. 408 Education Bldg. Raleigh, NC 27611	(919) 829-3739
Eckerlin, Dr. Herbert	North Carolina State University P.O. Box 5130 Raleigh, NC 27607	
Fields, W.O. Assistant State Super- intendent	Administrative Services Department of Public Education Rm. 338 Education Bldg. Raleigh, NC 27611	
Hall, Jim	Department of Public Instructions Raleigh, NC 27611	
Holbrook, Jim	Richard K. Hunger and Company P.O. Box 8357 Greensboro, NC 27410	
Johnson, Marvin Consulting Architect	Division of School Planning Department of Public Education Rm. 244 Education Bldg. Raleigh, NC 27611	

NORTH CAROLINA (cont'd)

Kahdy, George A. Deputy Assistant	State Superintendent for Program Services Department of Public Education Rm. 318 Education Bldg. Raleigh, NC 27611	
Kohl, Jerome Nuclear Engineering Extension Specialist	North Carolina State University Department of Nuclear Engineering P.O. Box 5636 Raleigh, NC 27607	
Lee, Nevada K. Consulting Engineer, School Planning	North Carolina Department of Public Instructions Rm. 238 Education Bldg. Raleigh, NC 27611	
Manz, R. R. Member	State Board of Education 600 Virginia St. Roanoke Rapids, NC 27820	
O'Kelley, Tom Assistant Director	Division of Plant Operations Office of the Superintendent of Public Instructions Rm. 410 Education Bldg. Raleigh, NC 27608	(919) 829-3739
Pierce, Dr. J. L. Director	Division of School Planning Department of Public Instruction Rm. 228 Education Bldg. Raleigh, NC 27611	
Rhinehardt, William R. Asst. Purchasing Administrator	State of North Carolina Purchase and Contract Division 116 W. Jones St. Raleigh, NC 27603	
Swearingen, Emilie F. Conservation Officer	Energy Division North Carolina Department M. & V.A. 215 E. Lane St. Raleigh, NC 27011	
Taylor, Paul H. Director	Division of Science Education North Carolina Department of Public Instructions Raleigh, NC 27611	
Tillett, Wm. F. Transportation Engineer	North Carolina State Board of Education Rm. 132 Education Bldg. Raleigh, NC 27611	

NORTH CAROLINA (cont'd)

Tolson, General John J. III Secretary	North Carolina Department of Military & Veterans Affairs Administration Bldg. 116 W. Jones St. Raleigh, NC 27611	
Von Cannon, Jessie	Department of Public Instruction Raleigh, NC 27611	
Widmer, Chris EDPA Fellow	Center for Occupational Education P.O. Box 5096 North Carolina State University Raleigh, NC 27607	
Winslow, Harvey	State Board of Education Department of Public Instruction Raleigh, NC 27611	

OKLAHOMA

Anderson, Dr. Carl	Oklahoma State University Stillwater, OK 74074	
Durham, Dean Norman N.	Graduate College Oklahoma State University Stillwater, OK 74074	(405) 372-6211 Ext. 6132
Hill, Richard G. Director	Oklahoma Department of Energy 4400 N. Lincoln Blvd., Suite 251 Oklahoma City, OK 73105	
Mayberry, John School Plant Services Administrator	State Department of Education Oliver Hodge Memorial Bldg. Capitol Complex, 2600 N. Lincoln Oklahoma City, OK 73105	(405) 521-3812
Rigsbee, Ken Educational Communications Representative	Phillips Petroleum Co. 4 D 3 Phillips Bldg. Bartlesville, OK 74004	(918) 661-4773
Stanley, Preston O. Administrative Assistant	Oklahoma State University 202 Whitehurst Stillwater, OK 74074	(405) 372-6211 Ext. 6132

OREGON

Jarrett, Chester W. Manager, Public Services	Portland General Electric Co. 621 S.W. Alder St. Portland, OR 97205	
Lewis, Ms. Mary Environmental Education Specialist	Oregon State Department of Education 942 Lancaster Dr., N. Salem, OR 97310	

PENNSYLVANIA

Benedetto, Harry J. Special Assistant to the Director	Pennsylvania Department of Education Box 911 Harrisburg, PA 17126	(717) 787-3976
Carey, Thomas W., Chief Facilities Management Division	Regional Office, Facilities Engineering and Construction Department of HEW P.O. Box 13716 Philadelphia, PA 19101	
Kennedy, John	Pennsylvania Department of Education Box 911 Harrisburg, PA 17126	(717) 787-3976
Preston, William D. Coordinator	Energy Conservation Products Group Sun Oil Company 1608 Walnut St. Philadelphia, PA 19103	

RHODE ISLAND

Boyle, Dan Safety Director	United Truck and Bus Service Company 325 Melrose St. Providence, RI 02907	(401) 467-8844
Conta, Dean Lewis D.	Engineering Department University of Rhode Island Kingston, RI 02881	(401) 792-2186
Essex, Stewart R. Capital Budget Specialist	Rhode Island Department of Education 199 Promenade St. Providence, RI 02908	(401) 277-2061
Wilson, C. J. Associate Director	Engineering Research University of Rhode Island Bliss Hall, Rm. 107 Kingston, RI 02881	(401) 792-2188

SOUTH CAROLINA

Black, Dennis	South Carolina Energy Management Office 1429 Senate St. Columbia, SC 29201	
Durham, Dr. R. A. Deputy Superintendent	Division of Finance and Operations South Carolina State Department of Education Rutledge Building, Rm. 1069 Columbia, SC 29201	

SOUTH CAROLINA (cont'd)

Hendrix, Ralph M. Director	Office of Transportation South Carolina Department of Education 1429 Senate St. - Rm. 512 Columbia, SC 29201
Hill, Robert R. Director of Personnel	South Carolina Department of Education Rutledge Bldg., Rm. 1108 Columbia, SC 29201
Linder, Ms. Alice Environmental Education Consultant	South Carolina Department of Education Rutledge Building Columbia, SC 29201
Morton, Dr. B. E. Jr. President-Elect	South Carolina Association of School Superintendents 28 Austin St. Williamston, SC 29697
Upshur, Robert I. Director	Office of School Planning and Building Rutledge Building, Rm. 1112 Columbia, SC 29201

SOUTH DAKOTA

Schooler, James C. Assistant Superintendent	Division of Elementary & Secondary Education State Capitol Building Pierre, SD 57501

TENNESSEE

Olithant, Ms. Cynthia	Tennessee Energy Office 250 Capitol Hill Building Nashville, TN 37219
Viken, Ms. Claudia Assistant to the Director	Tennessee Energy Office 250 Capitol Hill Building Nashville, TN 37219
Wert, Dr. Jonathan M. Environmental Education Specialist	321 Elkmont Road Concord, TN 37720
Winters, Gregory L. Environmental Health	Walters State Community College Morristown, TN 37814

TEXAS

Barnhill, William S. Jr. Higher Education Facilities Program Officer	Office of Education - HEW 1114 Commerce St. Dallas, TX 75202

TEXAS (cont'd)

Gerhart, Kenneth R. Director, Energy Conservation	Continental Oil Company Box 2197 Houston, TX 77001	
Gilley, Gabe Educational Director School Transportation	Texas Education Agency 201 East 11th St. Austin, TX 78701	(512) 475-2631
Psencik, Dr. Leroy F. Program Director Social Studies	Texas Education Agency 201 E. 11th St. Austin, TX 78701	
Story, C. S. (Bill) Program Director	Texas Education Agency 201 E. 11th St. Austin, TX 78701	(512) 475-3653
Tillman, Walter H. Planner (Energy Resources)	Governor's Office Division of Planning Coordination Sam Houston State Office Building Box 12428 Austin, TX 78711	(512) 475-2782

UTAH

Peterson, Richard S. Specialist Science Education	Utah State Education Agency 1400 University Club Building 136 East South Temple Salt Lake City, UT 84111	(801) 328-5061

VERMONT

Fabian, Edward J. Director	School Administration Services Vermont Department of Education Montpelier, VT 05602	
Kautz, Robert B. Superintendent	Washington West Supervisory District Box 351 Waterbury, VT 05676	(802) 244-8877

VIRGINIA

Dishner, Riland Assistant Superintendent	Professional and Education Support Services State Department of Education Richmond, VA 23216	
Horn, Robert L. Jr. Coordinator Emergency Service Activities	Department of Education Commonwealth of Virginia P.O. Box 6Q Richmond, VA 23216	

VIRGINIA (cont'd)

Reynolds, William (Red) V.	National School Transportation Association P.O. Box 324 Fairfax, VA 22030	(703) 323-5900
Slayton, Addison E. Jr. Chief, Support Division	State Office of Emergency Services 7700 Midlothian Turnpike Richmond, VA 23235	
Tyler, Dr. James W.	301 North 9th St. Richmond, VA 23261	

WASHINGTON

Andrews, Phil	KRAB - FM 1406 Harvard Seattle, WA 98122	
Bessey, James	Department of Social & Health Services P.O. Box 1788 Olympia, WA 98504	
Carnaham, Don M. Supervisor Transportation, Traffic & Safety Education	ISD 110 100 Crocket St. Seattle, WA 98109	
Chisom, Charles B. A/A Technical Director	Washington School Building Systems Project SPI Old Capitol Building Olympia, WA 98504	
Cole, Richard J.	Federal Energy Administration 909 First Ave., Rm. 1151 Seattle, WA 98104	
Diamond, Lawrence	Department of Emergency Services Washington State Energy Center Olympia, WA 98504	
Downie, Dick Board Chairman	Energy and Man's Environment P.O. Box 1107 Everett, WA 98206	
Johnson, Lee	Federal Energy Administration 909 First Ave., Rm. 1151 Seattle, WA 98104	
Kennedy, David Supervisor, Environment Education	Office of Superintendent of Public Instruction Old Capitol Building Olympia, WA 98504	(206) 753-2574

WASHINGTON (cont'd)

London, Elmer F. Transportation Consultant	100 Crockett St. Seattle, WA 98109	
Long, Milo W. Coordinator, Energy Conservtion	State Office Superintendent of Public Instruction Old Capitol Building Olympia, WA 98504	
Mommsen, Robert Regional Architect	HEW/ROFEC J.S. 623 1321 Second Ave. Seattle, WA 98101	
Robertson, Jack B. Administrator	Federal Energy Administration 909 First Ave., Rm. 1151 Seattle, WA 98104	
Rowley, Lloyd Director	CISPUS Environmental Center Rt. 4 Randle, WA 98377	

WEST VIRGINIA

Keenan, Charles E. State Director	School Transportation West Virginia Department of Education 1900 Washington St. East Building 6, Rm. B-258 Charleston, WV 25305	(304) 348-2711
Seymour, Robert Program Specialist, Science	West Virginia Department of Education Capitol Complex Charleston, WV 25305	

WISCONSIN

Engleson, David C. Environmental Education Consultant	Department of Public Instruction 126 Langdon St. Madison, WI 53702	(608) 266-3319
Kobs, Del A. Supervisor, Pupil Transportation	Wisconsin Department of Public Instruction 126 Langdon St. Madison, WI 53702	(608) 266-2853
Tinglum, Jahn H. Coordinator, School Facilities	Wisconsin Department of Public Instruction 126 Langdon St. Madison, WI 53702	(608) 266-2803

WYOMING

Roberts, Stephen R. Title V Consultant	State Department of Education State Office Building West, Rm. 256 Cheyenne, WY 82002	(307) 777-7621 or -766-3052

ZAIRE

Kiavilla, Nkuasi Director of Education	Kinshasa, Zaire

This publication was financed by funds provided by the Elementary and Secondary Education Act of 1965 (Public Law 89-10, Title V, Section 505). However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S. Office of Education and no official endorsement by the U.S. Office of Education should be inferred.

SECTION

II

MATERIALS FOR DISTRIBUTION TO SCHOOL DISTRICTS

ENERGY CONSERVATION IN EXISTING SCHOOL FACILITIES: AN OVERVIEW

INTRODUCTION

According to American School and University magazine's annual Maintenance and Operations Cost Study, the median U.S. school district spent, in 1972, about $270 for each 1000 square feet. Estimates by the National Science Foundation indicate that today's buildings waste as much as 40 percent of the energy they consume. A quick calculation shows that taxpayers' money in the amount of $108 per 1000 square feet of educational plant went up the flue or out the window in a median district.

For school administrators, energy conservation in the design, construction, programming, and operation of school plants is both an essential and an ethical obligation. Essential because of the rapidly rising costs and unpredictable supplies of energy; ethical because the school district administration is both the steward of public monies and the leader of education in the community.

Recent experience is showing that energy conservation programs in schools can result in dramatic and immediate savings in tax dollars. Data gathered recently by Educational Facilities Laboratory (EFL) indicates that at least $4,000 per year in fuel and utility costs in a typical elementary school can be saved by reducing energy waste. The amount comes to over $10,000 per year in secondary schools. One small Colorado school district, Northglenn, through careful auditing of its energy usage patterns and through an organized program of energy conservation, is now saving in excess of $3,000 per month on its gas and electric bills.

It is hoped that the following discussion of energy conservation in school facilities will encourage district personnel to follow the successful examples of other school districts in reducing energy waste.

TABLE OF CONTENTS

	Page
Programmatic Modifications	1
Operational Modifications--Lighting	2
Cutting Waste in Heating and Cooling	4
Proper System Maintenance	7
Energy Saving Through Plant Modification	8
Mechanical Systems.	8
Lighting Systems	8
Summary	10

Energy Conservation in Existing Facilities

When an educational facility is viewed as a system composed of plant, students and teachers, materials, support staff and program, one can identify three levels at which energy-saving strategies can be developed and implemented. These levels are:

1. The programmatic--the educational program and schedule of activities taking place at the school.

2. The operational--how the facility and its supporting systems are run to house and support these educational activities.

3. The physical plan and its operating system.

In general, programmatic and operational changes are only modifications in the way the existing facility is used and, therefore, usually entail little or no expenditure. On the other hand, changes to the physical plant or to one or more of its operating systems may be quite expensive.

Practical energy-saving strategies at each of the three levels are discussed in the following sections.

Programmatic Modifications

The educational program and schedule of daily activities are normally considered as a stable factor around which all other elements in the school system must revolve. The school's program reflects its primary function; the encouragement of learning and the sharing of knowledge. Most programs and schedules, however, have some room for trade-offs which can result in energy savings.

One such trade-off is the proper use of a plant at night or on weekends when it is less than fully occupied. If activities during these times are scheduled in such a way that all the spaces used are in a single heating or cooling zone, or are at least adjacent, the remainder of the plant can be shut down and the minimum of energy used.

The effect of programmatic changes on energy consumption is shown by a study of a "typical" Colorado school commissioned by the Colorado Department of Education. Using a computer simulation package, the study discovered the following energy variations resulting from variations in scheduling:

> Shutting down the school completely during Christmas Vacation and the month of January could result in an annual heating fuel savings of 23.9 percent.
>
> Extending Christmas Vacation another week could result in heating fuel savings of 5.8 percent per year.

Starting school as late as 11:00 a.m. in the winter and running later in the afternoon would save only about five percent of the heating fuel per year.

Using the school on a year-round basis, requiring air-conditioning in the summer months, would add 61.2 percent to the annual fuel and electricity bill.

By turning heat on at 7:00 a.m. and off at 3:00 p.m. indicates that actual fuel consumption could be reduced by 13.8 percent annually.

Another scheduling technique that encourages energy conservation involved programming space use so as to place visual tasks in areas of specially designed lighting. This procedure can save considerable electrical energy by allowing a reducation in the general lighting level. In addition, visual tasks themselves may be modified. For example, the reading of #2 pencil on manila paper requires about fifty times as much light as reading felt-tip pens on matte white paper.

Operational Modifications--Cutting Waste in Building Lighting

There are three ways of reducing a school plant's waste of lighting energy. These may be used separately or in concert. They are: (1) reduce the number of lamps; (2) turn off the lamps in unoccupied spaces; and (3) make use of natural lighting when available.

1. Reducing the number of lamps: Lighting wattage in existing buildings may be reduced either by removing a percentage of flourescent tubes or by replacing incandescent lamps with bulbs of lower wattage. (Table I shows the annual costs of maintaining various lighting levels.) If this approach is used, reductions in teaching space lighting levels should be based upon careful consideration of what amount of lighting is appropriate.

Programs of this sort have been implemented in school districts all over the country. The facility director of an eastern district reported that since voluntary light use reduction efforts rapidly lose their ferver, the only way he can achieve his desired savings is by removing tubes. The director of an energy conservation program in a West Coast district reported that he had 500 watt incandescent bulbs in classrooms replaced with 350 watt bulbs over a weekend and space users never noticed the difference.

2. Voluntary light turning-off programs: The failure of Americans to turn off lights in rooms they leave is so notorious that a few years ago an American President was the butt of humor because of his attention to this detail.

TABLE I

COMPARATIVE ANNUAL ELECTRICAL

CONSUMPTION AND COSTS

FOR VARIOUS LIGHTING LEVELS

(28,000 square foot plant, $0.025 per KWH)

	School Plant Used 9 months Per Year	School Plant Used 12 Months Per Year
30 footcandles	37,750 KWH ($ 944)	52,100 KWH ($1302)
50 footcandles	64,200 KWH ($1600)	88,500 KWH ($2215)
70 footcandles	85,600 KWH ($2140)	118,500 KWH ($2960)
100 footcandles	128,600 KWH ($3210)	177,500 KWH ($4440)

Few school buildings achieve more than 75 to 80 percent space utilization and if lights were conscientiously turned out in vacant spaces, up to one-quarter of the electrical bill could be saved with no change in lighting levels.

Numerous school districts and institutions of higher education have instituted programs to encourage the turning off of unused lights and other equipment by their facilities and students. Some of the activities by zealous savers can have comical results as anyone who has sat in a suddenly-darkened office cubicle or toilet stall can attest. Unfortunately, the success of these programs seems to fluctuate in an inverse relationship with the availability of gasoline.

Another approach, somewhat more consistent in its results, is to appoint student or staff monitors with responsibility for turning off lights when a room is empty and to periodically check the rooms in the plant for use.

3. Use natural light if you have it. If a building receives natural light through windows and skylights, the use of artificial lighting in the rooms should be adjusted accordingly. Some older school plants have separate switching circuits for banks of lights near the windows, a useful idea which could be added to all school plants with large window areas and, if properly used, could result in considerable energy savings. A study indicates that each linear foot of properly designed window (measured along the sill) can save up to 100 kilowatt-hours per year.

Cutting Waste in Heating and Cooling

The maintenance of a healthful and comfortable interior environment requires that the temperature and humidity be maintained within the "comfort zone" of conditions illustrated in Figure 6. Although conditions are often expressed as a single set of figures (such as 75°F, 50 percent relative humidity), an examination of Figure I shows that comfort conditions are actually a range of values, slightly different for summer and for winter and for different activity levels.

In an existing plant, maintenance of these desired conditions can be assured (with minimum energy consumption) by taking three steps: (1) setting the thermostats lower in winter and higher in summer; (2) reducing and controlling the amount of outside air taken in; and (3) using appropriate setbacks when the plant is not occupied.

1. Change thermostat settings: The study sponsored by the Colorado Department of Education found that reducing the thermostat setting (room temperature in classrooms from 75°F to 68°F in winter could save an estimated 23.4 percent of the annual heating fuel consumption. From an examination of the comfort zone in Figure I, the reader can see that a setting of 68°F is still within the range of comfort, provided that the humidity level

is not too high. Spaces in which more rigorous activities take place can be further reduced in temperature; in fact, such reductions are beneficial to the person engaging in these activities. The following figures are given for space temperatures by the New York State Education Department's "Energy Usage Guidelines:"

Classrooms	68°F
Shops	63-65°F
Gymnasiums	63-65°F
Storage and other non-student spaces	50-55°F

The wearing of suitable clothing, especially covering the arms and the ankles, increases comfort over a broad range of temperatures and the school should recommend warm apparel in winter and cool in summer.

2. Control outside air intake: Outdoor air is introduced into a building in two ways--intentionally for the purposes of ventilation and air freshening, and unintentionally through flaws in the building fabric and by the opening and closing of doors and windows. Whenever outside air is introduced into the building, it must be treated--heated or cooled--to match the conditions of the air in the spaces of the building. Up to one-half of the total heating and cooling bill may come from this treatment of intentional and/or accidental outside air intake.

Controlling outside air introduction so that only as much air as is required is brought into the building is one major energy savings in school plants. In buildings with mechanical ventilation, this control includes sealing of the plant against accidental introduction of outside air, or "infiltration," checking the settings of outside air intake dampers to insure that only the desired amount of air is actually being introduced, and shutting off the outside air fans when the plant is not occupied. EFL research indicates that the operation of intake and exhaust fans during unoccupied hours is a major cause of energy waste.

An energy study, undertaken in Fairfax County, Virginia, estimated that in buildings relying upon intake and exhaust fans, a reduction of 50 percent in the outside air intake is possible. This reduction, which still puts ventilation rates above the minimum requirements, would result in annual energy savings of about 25 percent. In a typical secondary school, this means an annual savings of about $11,000 with no investment.

Control of outside air introduction in buildings relying on natural or gravity ventilation is trickier, but taking appropriate action, such as weather-stripping windows and sealing cracks, can still result in energy savings. The Fairfax computer simulations put these savings at about 35 percent if the level of outside air introduction could be held to recommended levels.

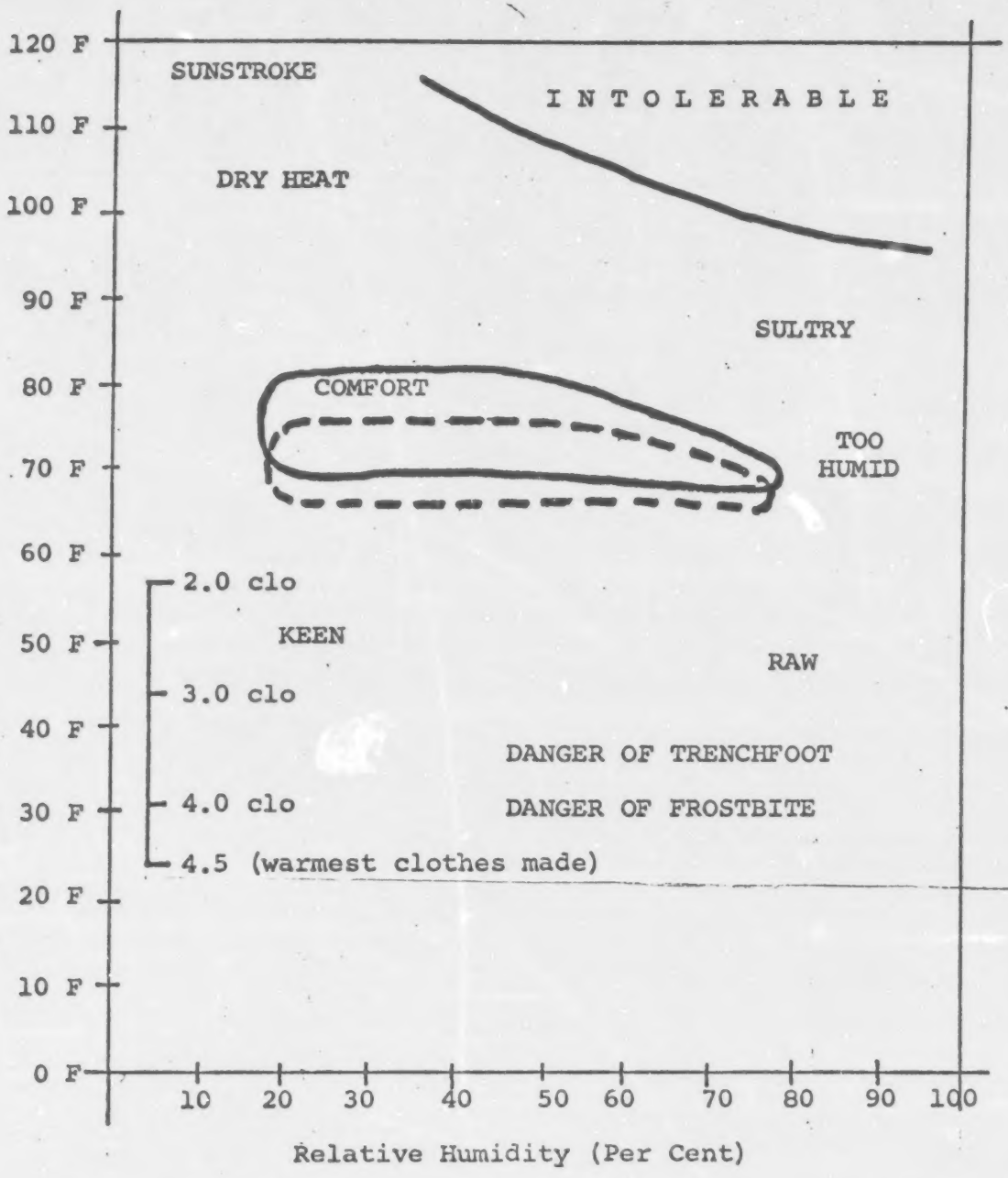


FIGURE I

Human Comfort Zone

SOURCE: Victor Olgyay, Design with Climate, pp. 19-24.

3. Setback of the system: Appropriate setback of the mechanical system during unoccupied periods is another source of energy savings which offers big results for little cost. Although most buildings built in the last three decades are equipped with setback controls, EFL experience indicates that as many as one in three of these units may not be effective because of malfunction and a larger proportion because of improper use. This is to remind the reader that even if an energy-saving device is provided, a certain amount of supervision is necessary to insure that it is used and used properly.

In setback, the load on the mechanical system is reduced by allowing the inside temperature of the building during unoccupied hours to fall in the winter and to rise in the summer--in mild climates, the system may be completely turned off during these times. Most thermostats allow a heating setback to 55°F and other units are available which go lower than this figure. The Colorado and Fairfax county studies indicate that a setback of winter temperature to 60°F from 70°F (roughly the same as any 10° setback) will result in savings of from 12 to 20 percent of annual heating fuel consumption. For the Virginia high school mentioned earlier in this discussion, this means annual fuel cost savings of over $18,000.

Proper System Maintenance

It is a truism that well-maintained systems operate more efficiently. In spite of this fact, however, one energy expert has estimated that as many as 80 percent of school building mechanical systems operate improperly due to poor or nonexistent maintenance.

Part of this problem is due to the absence of appropriate training programs for custodial, maintenance, and supervisory personnel. Two notable efforts to alter this situation have offered to make their materials and assistance available through the IECL Clearinghouse. The Division of Engineering of the North Carolina Department of Education has an extensive and successful program of workshops and video tapes which are used to train plant custodians and maintenance personnel in proper maintenance and operations of their buildings. This program includes such energy-related topics as testing burner efficiency and manual shifting of electrical load to reduce peak demand.

The second program has been developed as part of a community college curriculum by the Portland (Oregon) General Electric Corporation (PGE) in cooperation with a community college and several area school districts. In this program, the community colleges offer regular courses for custodians and maintenance personnel with full credit available. PGE provides materials and instructors for the program. Further information about both of these and other programs can be obtained from the IECL Clearinghouse.

Energy Savings Through Plant Modifications

Assuming that a plant is operating relatively efficiently, that is, with little or no wastage of energy, it may be necessary to invest funds in the plant in order to achieve further energy savings.

An effective analysis of energy-saving strategies which require investment cannot be made without some form of life-cycle cost analysis.

Mechanical Systems

Wearing out of the system or of its components or the preparation of a cost/benefit analysis may indicate the advantage of replacing all or part of the mechanical system in an existing plant with one which has better energy consumption characteristics. For example, providing a separate water heater or a smaller supplementary boiler may result in fuel savings in mild climates. It may also be found that existing mechanical plants have surplus capacity which may be used for additions, other plants, or other uses.

Several manufacturers now produce systems which are designed to be placed into existing plants and which provide efficient heating, ventilating and/or cooling while making extensive use of salvageable portions of the plant's existing systems.

In plants with central systems, the use of a heat recovery device between the outdoor air intake and exhaust air streams should be considered. The estimate prepared for the Fairfax County energy study indicated that at the two secondary schools to which this technique was applicable, such devices would pay for themselves in 5.9 and 6.8 years respectively. The annual energy cost savings at each of the two schools would not be in the neighborhood of $16,200 with these devices.

Improved control systems can be fitted to most existing plants at moderate expense and can greatly reduce consumption and costs. Time-sharing computer control of building systems is also available in some locales.

Lighting Systems

Upgrading of the lighting system of a plant is a common element of most modernization programs. When such upgrading is done, the designer should be careful to select the most efficient type of lighting source and to design it for low general levels with higher levels only where needed. The higher the lighting output per watt of input power, the lower will be the energy consumption to achieve any desired level of lighting--Table II lists some available high output lighting systems.

Switching patterns for lighting should allow for use of daylight and for some flexibility of use. The exterior banks of lights should be switched, either manually or automatically by photoelectric cells, to permit turning them off when adequate natural light is available. Two-level switching may be provided and teachers instructed in its use, to allow varying light levels in the classroom to respond to different educational activities.

TABLE II

EFFICIENCIES OF VARIOUS LAMP TYPES

Fluorescent lamps provide 3 times the lumens per watt of a standard incandescent (filament) lamp.

Fluorescent lamps lose efficiency at their ends. Efficiency is gained by the use of fewer and longer tubes:

2 - 24 inch cool white lamps = 50 lumens per watt

2 - 48 inch cool white lamps = 70 lumens per watt

2 - 96 inch (800 MA) lamps = 73 lumens per watt

High Intensity Discharge (HID) lamps:

400 watt metal halide lamp = 75 lumens per watt

1000 watt metal halide lamp = 85 lumens per watt

SOURCE: Charles D. Gibson, "Energy Saving Efforts Related to Lighting" (paper read to Southwest Regional Conference of the Council of Educational Facility Planners, International, Sacramento, California, April 20, 1974).

SUMMARY

In this section, a number of techniques which may be used to conserve energy in existing plants have been introduced. An effort has been made to view the school as a system composed of a number of elements--plant, users, program, schedule--and to show how energy may be saved with each of these elements.

A great deal of energy can be saved, with little or no cost by looking at the energy that plants are actually doing and then by reducing excessive and unnecessary operations and activities. Squeezing this waste out can result in annual cost savings of at least $4,000 in a typical elementary school and in excess of $10,000 in a typical secondary plant. Modifications requiring investment can and will produce further energy and cost savings if wisely made--life-cost analysis can help direct these investments.

For Further Information

Energy Conservation and the Building Shell. Educational Facilities Laboratories, Inc. Menlo Park, California: July 1974, 28 pgs (available from BSIC/EFL, 3000 Sand Hill Road, Menlo Park, CA 94025, $3.00 postpaid).

The Economy of Energy Conservation in Educational Facilities. Educational Facilities Laboratories, Inc. New York: EFL, 1973, 81 pgs (available from EFL, 477 Madison Ave., New York, NY 10022, $2.00 postpaid).

"Energy Crisis." Nation's Schools, (January 1974) pp. 31-54 (available as reprint from Nation's Schools, 230 W. Monroe St., Chicago, IL 60606, $1.50 per copy).

"Energy Crisis: What Schools are Doing about It." American School and University. (February 1974) pp. 53-60.

Technical Options for Energy Conservation in Buildings. U.S. Department of Commerce, National Bureau of Standards. NBS Technical Note 789. Washington: U.S.G.P.O., July 1973, 184 pgs (available as SD Catalog No. C13.46:789 from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, $2.35 postpaid).

For information on IECL's Clearinghouse, write to:

ENERGY
Colorado Department of Education
201 E. Colfax Ave.
Denver, CO 80203

AN OUTLINE FOR A DISTRICT-LEVEL PLAN FOR ENERGY CONSERVATION

TABLE OF CONTENTS

	Page
The District Energy Conservation Team	1
Specific Duties for Specific People	2
Planning for the Development of Guidelines	2
An Energy Audit System	3
Follow-Up and Evaluation Procedures	4
Checklists vs. Suggestions	5
Samples of Audit Forms	7
List of Energy Conservation Suggestions	21

AN OUTLINE FOR A DISTRICT-LEVEL PLAN FOR ENERGY CONSERVATION

There is, of course, no single format for an energy conservation program which will adequately fill the needs of all school districts. There are too many variables involved from one region of the country to the next. In the process of reviewing a number of conservation programs there are several features that are shared by all successful conservation efforts. These include:

a) The formation of a district energy conservation committee or team which involves as many segments of the educational community as is practical.

b) The assignment of specific responsibilities to specific individuals.

c) Careful planning in the development of guidelines.

d) The recording of energy use patterns--an "energy audit"--for each building in the district.

e) Persistent follow-up and evaluation efforts to see that established guidelines are followed.

The District Energy Conservation Team

The word "team" is important here. Any conservation effort, if it is to be successful, must have the cooperation from all elements of the educational community. The size and composition of the team will vary according to the needs and aims of the school district involved. A typical energy conservation team from a large school district might involve the following persons:

- The Superintendent or his representative
- Building principals or their assistants
- A district energy manager (a person assigned the specific task of administering the energy conservation program)
- Food Services personnel
- The district business manager
- A representative from the Parent Teachers Association

Note: In the report that follows we have relied heavily although not exclusively upon the experience of Colorado's Northglenn school district which has had extensive experience organizing and conducting a conservation program. During the first nine months of 1974 this suburban district saved an average of over $3,000 per month on its gas and electricity bills in spite of a 5% increase in rates.

A representative from the board of education

Teachers

Students

Maintenance and custodial staff

A representative from the utilities company serving the district

Outside professionals such as architects and architectural engineers

Transportation staff

It is suggested that the selection process for this committee be conducted thoroughly and carefully. Persons selected should be sincerely interested in the project and there should be a reasonable expectation that they will actively participate.

Some observations on the categories of personnel involved in the team: The Northglenn experience suggests that it is highly important that the district superintendent be "visible" in all phases of the program either through his representative or, preferably, in person. The presence of the superintendent lends the sense of direction and purpose to the conservation effort. It is also important that one person be selected as team leader.

In Northglenn, a district-level maintenance team was organized. This team made regular visitations to each school to assess its energy usage and its conservation needs.

It is suggested that wherever possible, conservation teams be organized on the school building level as well.

Specific Duties for Specific People

The implementation of the guidelines drawn up by the district conservation team must not be left up to chance or the good intentions of the program participants. Conservation programs are effective only when specific tasks are made the responsibility of specific individuals. Moreover, it is important that each member of the district team be aware of the person responsible for specific duties. Wherever possible there should be some system that insures that persons signify in writing that their task has been completed. (See below, section on checklists.)

Planning for the Development of Guidelines

There should be ample time set aside for the planning phase of any conservation program. Participants should be notified well in advance of the time, place, and purpose of the planning meeting. An agenda should be prepared well ahead of time. If the scope and intent of the

program warrants, more than one meeting may be necessary. Organizers should not be discouraged if this planning phase seems to be eating up time: A successful conservation program is founded on careful planning and well-thought-out procedures.

The following are some suggested agenda items that might be explored during the planning and organization meetings of the conservation team:

--The assignment of responsibilities and tasks to specific groups and individuals

--A thorough review of the district's energy situation

--Strategies for the involvement of the entire educational community

--The planning of an energy audit for the school district

--The formulation of evaluative and follow-up procedures

--The setting of goals and the establishment of time-frames for the achievement of these goals

--The planning of a public information program to inform district personnel and the community about the existence of the project and its goals

--The preparation of energy conservation checklists for district and school building use

--The possibility of consulting outside experts in the field of energy management

An Energy Audit System

The Energy Audit System involves developing a record of the energy use patterns in each building in the district. (Not just schools but garages, storage areas, and administrative buildings as well.) The Energy Audit is an indispensable tool in any conservation program. It serves the following purposes:

1) It shows where energy money is going and therefore pinpoints areas where energy savings are possible by providing monthly energy cost comparisons

2) It makes possible the preparation of an "energy budget" so that administrators can begin to think of dollars and BTU's in the same terms

3) An Energy Audit, by showing graphically where energy costs are concentrated, encouraged students, teachers, and administrators to try harder to cut energy waste

A school district should attempt to collect a base amount of information on each of its plants. At the very least this should include:

1) The type and amount of each fuel used

2) The amount of electricity used

3) The peak demand level for this electricity

District personnel may meet with some initial difficulty in establishing the history of a plant's energy usage. Records may not have been properly maintained or they may be difficult to locate. But as information gathering techniques become more advanced, the audit procedures will be made to yield more useful information such as energy dollar cost per student, per plant, per square foot, etc.

It should be mentioned here that very often the utilities company serving the school district offer their help and cooperation in conducting Energy Audits and usage measurements. In some regions this service is provided free of cost to the district.

A number of different audit forms are included in this report for the reader's inspection.

Follow-up and Evaluation Procedures

Even the best of programs tend to lose momentum with time. Follow-up efforts should be planned in order to overcome any inertia that may set in. This can be managed in a number of ways but it is essential that people, not just paper, be involved in this process. For example, a letter from the superintendent urging principals to step up their conservation efforts is not half as effective as a constructive visitation from a district maintenance team to identify energy consumption problems and correct them. These visitations, by the way, should be done in the spirit of rendering assistance and should not be undertaken so as to pose a threat to the school's principal or its maintenance and custodial staff. It is important that all district personnel in-

---

Note: Goals that are established in the early stages of the program should be realistic. Energy waste is an ingrained habit in this country and the best of energy conservation programs take time to establish and implement. There should be room for flexibility so that goals set early in the project can be revised.

volved in the project feel as though they are working together for a common goal.

The materials accumulated as a result of the Energy Audit will, of course, provide an excellent data base for the purpose of comparison and evaluation. It should be mentioned in this regard, however, that some disagreement exists as to whether the results of the monthly Energy Audits for district plants should be published. Those who argue negatively say that this procedure promotes hard feelings on the part of those administrators whose schools have not done well in energy conservation efforts. The argument in favor of making these monthly audits public say that this stimulates the desire to conserve energy and encourages a spirit of competition. The Northglenn school district, incidentally, publishes the results of their audits. The district has found that, overall, the publication of results has had a positive effect.

Checklists vs. Suggestions

In consulting this section the reader should bear in mind the distinction between a "checklist" on the one hand, and a "list of ideas" on the other.

In terms of an energy conservation program, a "checklist" sets out a list of duties for which some person is specifically responsible. In other words, a checklist is meant to be "checked off" by someone whose job it is to take care of the items in question.

The list of ideas included here may be altered or restructured so as to produce a checklist. If this is the intent of the organizers of a conservation program they should remember that in order to be effective a checklist should have at least some of the following characteristics:

1) The checklist, wherever possible, should bear the names or titles of those responsible for performing the duties on the list.

2) The list should include a space for a signature (note: a signature, not just a check mark) and, where applicable, a place to indicate the time and date when the item was taken care of.

3) Checklists, wherever possible, should be kept in a convenient and permanent location (i.e. for a transportation checklist, the bus garage--for a maintenance list, a place where the appropriate personnel are regularly located).

4) Checklists should be collected and reviewed on a regular basis by supervisory personnel.

A word of caution: The literature of energy conservation in school facilities is glutted with so-called checklists. One gets the distinct impression that too often school administrators fool themselves into thinking that simply by handing down checklists energy consumption will magically drop. Nothing could be further from the truth. Checklists are merely one means to an end, and in order to be effective they must be used properly. To repeat a point made earlier, successful programs are carried out by people, not paper. Responsibility for the handling of the checklist must be delegated and there must be some administrative mechanism to insure that this responsibility is carried out.

97

SAMPLES OF AUDIT FORMS

The following pages are samples of Energy Audit and Recap Forms.

Sheet A is an Energy Audit Form used by the Texas Education Agency. This is a quarterly report for the use of school districts in reporting to the state agency, nevertheless it could be used by districts for individual school plants. Note that this form requests a comparison with a previous year.

Sheet B is a sample of an audit form used by Lake Washington School District, Kirkland, Washington. Note that this district is concerned with water consumption as well as the use of oil and electricity. Totals on this form are indicated by BTUs whether the source was gas or electricity. Note also that there is a space for indicating amount of BTUs per student and per square foot of building space.

Sheets C and D, provided by Educational Facilities Laboratories, is somewhat more sophisticated than the others. This "Self-Help Audit Form" is a report on annual fuel consumption. Note that page two of this form provides the mathematical factor for transforming measurements in KWH, MCF, and Gallons to 1000 BTUs.

Sheets E and F are district recaps of energy usage in three schools of Colorado's Northglenn District. One sheet is for electrical usage, the other is for gas. Note that usage is expressed here in kilowatt hours and cubic feet. Note also that a summary of average monthly Colorado temperatures is included so that energy use fluctuations due primarily to weather can be identified.

SHEET A

District Name

TEXAS EDUCATION AGENCY
Division of Administrative Services

Co.-Dist. #

Quarterly Energy Consumption Report

For Quarter Ending _____

CATEGORY	AMOUNT CONSUMED	AMOUNT CONSUMED DURING THIS PERIOD LAST YEAR
Electricity	_____ KWH	_____ KWH
Natural Gas	_____ Mcf*	_____ Mcf*
Gasoline	_____ gallons	_____ gallons
Fuel Oil	_____ gallons	_____ gallons

*Mcf is equal to one thousand cubic feet of natural gas.

Other Fuels (specify butane, propane, etc.)

_____ _____ _____

_____ _____ _____

☐ Check this box if your district would like a member of the Governor's Energy Resources.

☐ Check this box if your district presently includes energy studies and/or conservation or energy in your instructional program.

_____
Typed Name

_____
Signature of Reporting Official

_____
Date

_____
Address

Report due by last day of the month following the quarter for which the report is being made. Forward report to:

Director, Division of Administrative Services
Texas Education Agency
201 East 11th St.
Austin, Texas 78701

5/10 99

SHEET B

ENERGY CONSUMED

TOTAL WATER CONSUMED AT SCHOOL _____

CU/FT WATER CONSUMED PER STUDENT _____

TOTAL OIL BTU'S CONSUMED AT SCHOOL _____

TOTAL ELECTRIC BTU'S CONSUMED AT SCHOOL _____

TOTAL GAS BTU'S CONSUMED AT SCHOOL _____

TOTAL BTU'S CONSUMED _____

DIVIDED BY THE NUMBER OF STUDENTS _____

BTU'S ENERGY CONSUMED PER STUDENT _____

DIVIDED BY THE SQUARE FEET IN BUILDING _____

BTU'S ENERGY CONSUMED PER SQ.FT. IN BUILDING _____

SHEET C

SELF-HELP ENERGY AUDIT FORM

PLANT_____ DISTRICT _____ YEAR_____

Obtain fuel and utility billing data for the full year and enter in the appropriate places in the following table. Note that the fuel columns require information on the type of fuel and the units of delivery, such as kilowatt-hours, therms, gallons, etc. Total each column except PEAK DEMAND (KW).

	Electricity		Fuel(s)	
	Usage (KWH)	Peak Demand (KW)	Type _____ Unit_____	Type _____ _____
JULY				
AUGUST				
SEPTEMBER				
OCTOBER				
NOVEMBER				
DECEMBER				
JANUARY				
FEBRUARY				
MARCH				
APRIL				
MAY				
JUNE				
TOTAL				

After completing the consumption table above, center the TOTAL USAGE figures on the appropriate lines of the following page;

Enter	ELECTRICITY USAGE	on Line (1)
Enter	NATURAL GAS USAGE IN THERMS	on Line (4a)
Enter	NATURAL GAS USAGE IN Mcf	on Line (4b)
Enter	#2 FUEL OIL USAGE	on Line (7a)
Enter	#6 FUEL OIL USAGE	on Line (7b)
Enter	COAL USAGE IN LBS.	on Line (10)

SHEET D

PLANT _____ AREA _____ ft^2 YEAR _____

ANNUAL PLANT ENERGY USE

Col. A Annual Usage (Fuel Units)	Col. B Factor		Col. C Annual Usage (1000 BTU/yr)		Col. D Annual Usage (1000 BTU/yr/ft
Electricity:					
(1) _____ KWH	x 3.4	=	(2) _____	÷ Area =	(3) _____
Natural Gas:					
(4a) _____ Therms	x 100	=	(5a) _____	÷ Area =	(6a) _____
(4b) _____ Mcf	x 1000	=	(5b) _____	÷ Area =	(6b) _____
Fuel Oil:					
(7a) _____ Gal. #2	x 138	=	(8a) _____	÷ Area =	(9a) _____
(7b) _____ Gal. #6	x 146	=	(8b) _____	÷ Area =	(9b) _____
Coal:					
(10) _____ Lbs.	x 13	=	(11) _____	÷ Area =	(12) _____
TOTALS			(13) _____ 1000 BTU/yr		(14) _____ 1000 BTU/yr/ft

ANNUAL USAGE PER PUPIL

Annual BTU Usage		Enrollment		
_____ (Line 13 above)	÷	_____	=	_____ BTU/yr/pupil

SHEET E

SCHOOL DISTRICT NO. 12, Adams County

SUMMARY - ELECTRICAL USAGE*

September-December 1973

*All usage is listed by kilowatt hours.

NORTHGLENN HIGH SCHOOL (191,861 sq. ft.)

MONTH	1972-73	1973-74	NET CHANGE	PERCENT	USAGE PER SQ. FT.
					1972 .30
Sept.	59,080	73,040	+ 13,960	+ 23%	1973 .38
					1972 .29
Oct.	56,800	14,556	- 42,244	- 74%	1973 .07
					1972 .27
Nov.	52,960	68,760	+ 15,800	+ 29%	1973 .35
					1972 .84
Dec.	161,760	158,320	- 3,440	- 2%	1973 .82

THORNTON HIGH SCHOOL (64,300 sq. ft.)

MONTH	1972-73	1973-74	NET CHANGE	PERCENT	USAGE PER SQ. FT.
					1972 .06
Sept.	3,967	4,269	+ 302	+ 8%	1973 .06
					1972 .15
Oct.	10,104	12,705	+ 2,601	+ 26%	1973 .19
					1972 .22
Nov.	14,363	16,310	+ 1,947	+ 13%	1973 .25
					1972 .22
Dec.	14,539	13,508	- 1,031	- 7%	1973 .21

CORONADO JUNIOR HIGH SCHOOL (40,166 sq. ft.)

MONTH	1972-73	1973-74	NET CHANGE	PERCENT	USAGE PER SQ. FT.
					1972 .20
Sept.	8,170	9,550	+ 1,380	+ 16%	1973 .23
					1972 .31
Oct.	12,788	11,760	- 1,028	- 8%	1973 .29
					1972 .33
Nov.	13,626	13,746	+ 120	+ .8%	1973 .34
					1972 .24
Dec.	10,000	14,734	+ 4,734	+ 47%	1973 .36

SUMMARY OF AVERAGE MONTHLY

TEMPERATURES (Colorado)

	1972	1973	Loss (-) Gain (+)	
Sept.	62.1°	59.9°	- 2.2°	= 4% Loss
Oct.	52.0°	54.5°	+ 2.5°	= 5% Gain
Nov.	32.9°	39.5°	+ 6.6°	= 17% Gain
Dec.	24.9°	31.6°	+ 6.7°	= 21% Gain

17/18

SHEET F

SCHOOL DISTRICT NO. 12, Adams County

SUMMARY - GAS USAGE*

September-December 1973

*All usage is listed by cubic feet.

NORTHGLENN HIGH SCHOOL (191,861 sq. ft.)

MONTH	1972-73	1973-74	NET CHANGE	PERCENT	USAGE PER SQ. FT.
					1972 .062
Sept.	12,047	9,486	- 2,561	- 21%	1973 .049
					1972 .400
Oct.	76,868	15,312	-61,556	- 80%	1973 .079
					1972 .132
Nov.	25,422	13,979	-11,443	- 45%	1973 .072
					1972 .192
Dec.	36,874	24,734	-12,140	- 33%	1973 .129

THORNTON HIGH SCHOOL (64,300 sq. ft.)

MONTH	1972-73	1973-74	NET CHANGE	PERCENT	USAGE PER SQ. FT.
					1972 .009
Sept.	591	593	+ 2	+ .33%	1973 .009
					1972 .181
Oct.	11,683	6,251	- 5,432	- 46%	1973 .097
					1972 .172
Nov.	11,076	9,574	- 1,502	- 13%	1973 .148
					1972 .333
Dec.	21,431	14,139	- 7,292	- 34%	1973 .219

CORONADO JUNIOR HIGH SCHOOL (40,166 sq. ft.)

MONTH	1972-73	1973-74	NET CHANGE	PERCENT	USAGE PER SQ. FT.
					1972 .038
Sept.	1,550	376	- 1,174	- 76%	1973 .009
					1972 .049
Oct.	1,990	3,668	+ 1,678	+ 84%	1973 .091
					1972 .141
Nov.	5,666	4,062	- 1,604	- 28%	1973 .101
					1972 .215
Dec.	8,642	5,917	- 2,725	- 31%	1973 .147

SUMMARY OF AVERAGE MONTHLY

TEMPERATURES (Colorado)

	1972	1973	Loss (-) Gain (+)	
Sept.	62.1°	59.9°	- 2.2°	= 4% Loss
Oct.	52.0°	54.5°	+ 2.5°	= 5% Gain
Nov.	32.9°	39.5°	+ 6.6°	= 17% Gain
Dec.	24.9°	31.6°	+ 6.7°	= 21% Gain

Note: This is a list of suggestions. Not all of these ideas will be practical or necessary in all situations.*

HEATING, VENTILATION, AIR CONDITIONING

Heating

Vacuum clean tubes on all boilers at regular intervals to obtain maximum operating efficiency.

In multi-boiler systems, eliminate as many boilers as possible and still maintain heat.

Keep tubes in condensors clean to maximize heat transfer.

Close and cover baffles and vents on rooftop or window air conditioners during the heating season.

Treat boiler water chemically to reduce scale.

Maintain fuel/air ratio specified by manufacturers to ensure maximum combustion and minimum soot production. The insulating effect of a one-eighth inch layer of soot can add 8% to a furnace's fuel consumption.

Maintain proper burner alignment and condition. Determine the efficiency of each unit. Clean burner nozzles daily. Drain air tanks daily.

Carry out a monthly combustion analysis to assure optimum efficiency.

Provide for adequate combustion air in the boiler room.

Keep fuel oil at the recommended temperature at burner tip to ensure proper viscosity for complete combustion and to keep heat transfer surfaces soot free.

Clean all combustion air blowers monthly or oftener.

Lower the temperature setting for hot water that is heated electrically to the lowest acceptable level determined by building codes.

---

* IECL wishes to extend its thanks to the Ventura Public Schools, Ventura, California, and to the University of the State of New York whose conservation checklists and energy usage guidelines were consulted in drawing up this list of suggestions.

Ventilation

Do not allow the ventilating system to take in any outside air during the first half-hour of heating startup. Schools that have been empty for 12 hours or more are ventilated sufficiently by ordinary leakage.

Reduce outside ventilation to the fewest changes per hour that state and local codes permit. Consider no more than one air change per hour.

Check outside air dampers and controls regularly to be sure they are functioning properly.

Do not take in fresh air during unoccupied hours.

Regulate dampers on unit ventilators on buildings to reduce the amount of outside air brought in.

Be sure exhaust fans operate no more frequently than required. Put them on timers. Reduce speed.

Change or clean air filters on a regular basis.

Operate ventilation fans in kitchens and home economic classrooms only when cooking equipment is being used.

Do not operate air-handling units in rooms where the windows or doors are open.

Air Conditioning

Service air conditioners on a regular basis. Make sure maintenance men check and repair cooling towers; replenish refrigerant; examine fans, pumps, compressors, and other rotating equipment for poor seals, belt slippage, and other defects; check calibration of controls; and change filters.

Do not cool below a prescribed temperature, and do not operate air conditioning equipment when school is unoccupied.

Examine equipment to determine if several air conditioning systems can be combined to eliminate need to run and maintain several systems.

LIGHT(S)

Open window shades and draperies so as to take advantage of natural light on sunny days.

Install switches in rooms so that lights near windows can be turned off when there is sufficient natural light in that area.

Install a number of separate lighting circuits or dimmers for areas where high levels of lighting are needed only periodically.

Paint rooms and dividers with colors that reflect light. Keep walls, ceilings, and dividers clean; dark colors and dirt can reduce illumination by as much as 40 percent.

Place a brightly-colored sign next to light switches reminding people to turn off the lights in unoccupied areas.

Reset automatic timers for lights regularly to utilize all available daylight.

Check the sensitivity of automatic light controls to insure they are not triggered by fog or clouds passing over the sun.

Put lights on timers, photo cell, or astronomical clocks that turn lights off at given hours.

Outside security lights should be only bright enough to illuminate the areas needed.

When custodians are cleaning buildings at night, insist that they have lights on only in the rooms they are cleaning. When a cleaning task in a room has been completed, the lights should be turned off. Schedule daylight cleaning when possible.

Eliminate ornamental lighting.

Reduce lighting in hallways, corridors, storage areas, and outside the school to the lowest level safety and security will allow.

Initiate light turn-off programs to see that lights do not burn in unoccupied areas.

Reduce lighting levels in cafeterias, gymnasiums, and auditoriums.

Clean fluorescent tubes regularly. A tube will collect enough dust and dirt to reduce efficiency by 10 to 20 percent in 6 months and 40 percent in 2 years.

Replace lamps on a regular basis. Fluorescent tubes should be changed after 80 percent of their lamp life is used. Fluorescent lamps use more energy and produce less light during their last 20 percent of life.

Use fluorescent lights in suitable areas--they give more lumens per watt. One 40-watt fluorescent tube provides more light than three 60-watt incandescent bulbs.

Replace all outdoor and gymnasium lights with mercury vapor lamps. Use diffusers, new lens, polarizers, and special beam distributor units that can provide proper spread, focus, and use of illumination within a given space.

Inspect all light bulbs to insure that they are of the minimum voltage required.

Review recommended lighting standards. Often the so-called "minimum" standards require more light than is needed for reading and ignore non-reading activities entirely. (Lighting levels for most educational functions have doubled since 1960 and tripled since 1950.)

CONTROLS

Make sure custodians understand how to operate temperature settings on unit ventilators so they do not confuse the low-limit settings on these units with actual thermostat settings and overheat the room.

Establish the proper balance between temperature and humidity controls.

Have heating and air conditioning systems balanced regularly so that hot and cold spots in buildings are reduced to a minimum.

Shut off or put on night setback all air-handling equipment one-half hour before school closes. The building will maintain temperatures for a long period of time after controls have been shut off or reduced.

Set thermostats at the lowest setting that will not interfere with the learning process. Reduce heat in gymnasiums, locker rooms, and auditoriums. Eliminate heating in unused rooms such as closets, stairwells, etc.

Set back thermostats during weekends and vacations. Provide for overnight setback of thermostats either manually or by means of automatic control.

OPERATIONAL

Bring staff up to level of skill demanded by the equipment and controls. Establish an inservice training program for custodial and maintenance staffs. Utilize manufacturing representatives who can give instructions in operating pieces of equipment at maximum efficiency.

Recognize that operations and maintenance are two separate functions. Do not expect untrained, unskilled personnel to repair and maintain sophisticated equipment.

Curtail use of resistance-type electric equipment, such as space heaters, coffee pots, and hot plates.

Carefully develop specifications for the purchase of new equipment to insure that it is designed to use the minimum amount of energy.

Consolidate summer school class in adjacent rooms where possible to reduce the number of air-handling units needed. Place classes around the perimeter of the building to take advantage of natural ventilation and natural light through windows.

Schedule all evening meetings, PTA, and others for a single building so that night setback temperature can be retained in other buildings.

Encourage the wearing of warmer apparel during cold weather.

Be sure all windows fit tightly. Seal all openings around windows, doors, and other places where warm air could escape. Caulk old frames. Patch broken windows and damaged doors immediately. Double glaze windows, especially those on the north side.

Survey location of each room thermostat in relation to doors, windows, and hot or cold sources. Relocate for maximum energy savings.

Avoid blocking, heating, or cooling vents with furniture or draperies. Do not put anything on top of radiators. Keep all heating sources clear of furniture, draperies, bookcases, and files.

Allow sunlight into the building on cold days and keep it out on warm, humid days. Close drapes and blinds after school to reduce heat loss through window areas in the winter and to keep solar heat out during the summer.

Limit the number of entrances students and teachers use for arrival and departure.

Make sure that energy conservation as a subject area has a place in the school curriculum.

Schedule adult education programs to meet in rooms which receive full use during the day to utilize the existing room heat.

Encourage more efficient use of AV equipment through large group viewing.

Use centralized meeting places and combine meetings to allow personnel to travel together. Hold board meetings and PTA meetings during daylight hours where possible.

Organize work crews better to reduce travel.

Reduce the number of meetings of personnel.

SUGGESTIONS REQUIRING MODIFICATION

Install automatic door-closing devices.

Install heat recovery systems to trap and reuse waste heat that otherwise might be exhausted into the atmosphere. Use reclaimed heat for hot water and reheat to eliminate need to operate additional equipment.

Install independent gas or electric water heaters to allow complete shutdown of boilers in summer. Shutting off boilers eliminates heat created by steam mains in the building and takes a big load off air conditioners. If shutting off boilers is not practical, shut off all steam mains not required for water heating.

Replace hand valves on heating and air conditioning equipment with thermostatically-controlled automatic valves.

Install storm windows. Insulate attic and outside walls.

Lower ceilings, where possible, to reduce air space for heating.

Check and repair insulation throughout the building, especially in attic spaces and on pipes, boilers, and tanks.

Install systems that use waste heat from a school building's mechanical system to heat incoming air.

Redesign, remodel, or replace obsolete or inefficient equipment.

Install systems that control the heat generated by lighting systems. Do this by capturing the heat before it enters space either by drawing return air across the fixture and back to the mechanical plant or using water-cooled fixtures.

SPECIAL CLASSROOMS

Homemaking

Cook by time and temperature for best results. Use minute timer for precise cooking operations.

Repair all equipment immediately and establish routine maintenance schedules. Have all ovens calibrated.

Use cold-water washing when possible.

Reduce the size of freezers to minimize on-site storage of frozen foods.

Limit pre-heating of ovens to the very minimum. In some cases, pre-heating is not necessary.

Decrease the amount of hot food prepared.

Don't open oven doors more than necessary to check on foods being prepared.

Keep pots and pans covered while cooking whenever possible.

Make sure burners are completely off when not in use.

Use a stopper in sink when washing dishes by hand to avoid running hot water continuously.

See to it that students in homemaking classes are made aware of the necessity for energy conservation.

Don't allow leaky hot water faucets. Locate and repair any water or steam leaks immediately.

Lower temperatures in water heaters on weekends; turn off during vacations.

Match pan size to burner unit size.

Refrigerator and freezer should be kept more than half full. Items absorb and help hold cold.

Use high heat only to bring water to a boil or to start cooking food with water. Then reduce heat level to lowest possible point.

Use small amounts of water whenever possible; they heat faster.

Keep refrigerator and freezer coils clean; replace door seal when it no longer seals tightly.

Consolidate backing activities into one day of continuous use.

Use hood fans only when necessary.

Eliminate the use of electric can openers and other "convenience" appliances.

Shops

Reduce lighting to levels actually needed in work or training areas.

Use more hand tools; teach more hand skills; assign more students per power work station.

Coordinate shop use and classroom use for more efficient utilization of space in shop area.

Restrict use of doors in shops.

Reduce the number of forges, kilns, and smelters.

Include energy conservation techniques as a regular part of the shop curriculum.

Initiate useful projects in shops to help other departments in the school with equipment, repairs, etc.

Drama

Design activities for a more efficient use of multi-purpose rooms.

Reduce stage lighting through the use of dimmers. Use less and lower light during rehearsals.

Make sure that lamps and reflectors are kept clean.

Use regular classroom more when small groups are practicing or performing.

Art

Reduce hours of kiln use.

Organize more hand operations, especially in crafts.

Business Education

Restrict the use of electric typewriters and other electric machines. Use more hand-operated equipment.

Utilize more community and business facilities for training.

Make sure that all power equipment is turned off when not in use.

Use both sides of all paper products.

Physical Education and Sports

Restrict the use of showers to the very minimum. Reduce the capacity of shower heads to cut down on the amount of hot water used. Reduce water temperature in showers.

Lower swimming pool temperatures. Minimize filter pumping hours on pools.

Use solar heat for pools. Do not heat pools during warm or hot seasons of the year.

Keep gym temperature at 65 degrees or below.

Utilize commercial laundering of towels or have students bring their own towels.

Expand inter-mural competition to substitute for intra-mural.

Limit the geographical area of athletic competitions to reduce traveling by bus or car.

Conduct basketball, volley ball, and other game practice sessions outside as much as possible and during daylight hours.

Combine girls and boys sports as much as possible to reduce the number of hours facilities are used.

Shut off air-handling units and lights in gyms when physical education classes are being held outside.

Do not use electric scoreboards.

MAINTENANCE AND GROUNDS

Establish inservice training programs for custodial and maintenance staffs featuring experts in the field of thermostatic control and lighting as well as manufacturing representatives who can give instruction in operating pieces of equipment at maximum efficiency. Bring operations people up to the level of skill demanded by the equipment and controls.

Organize groundsmen and maintenance personnel assignments to minimize use of trucks. Equipmaintenance trucks with all necessary tools.

Monitor use of all vehicles used in maintenance and operations.

Ration gas for all equipment. Make it stretch.

Cut grass and edge less often.

Keep all gas burning engines tuned to peak performance.

Adjust temperature in buildings where custodians work to the lowest possible comfortable temperature for physical labor.

Make warehouse deliveries and messenger service to schools on a very minimal basis.

Reschedule room cleaning to daytime as much as possible to save electricity used at night.

Do as much cleaning as possible with cold water.

Lock gas tanks on all vehicles to avoid theft.

Control purchasing of equipment to obtain the correct size.

Encourage employees to bring their lunches rather than driving home or to a restaurant.

Use the minimum amount of water for sprinkling and irrigation.

TRANSPORTATION OF STAFF

Develop innovations and creative programs to encourage staff to walk to school or ride bikes.

Provide assistance in developing car pools for teachers and clerical workers in schools.

Use central place as point of embarkation for trips involving number of people.

Coordinate conferences out of district for sharing rides.

Use closed circuit television for meetings.

Utilize conference telephones as substitutes for small meetings.

Reassign teachers and clerical workers closer to their homes.

Coordinate transportation with other county agencies.

District personnel who serve a number of schools should plan on coordinating trips to include maximum contacts and include other district personnel serving the same schools.

Educate all workers before they embark on a trip to ask themselves: Can I deliver or do something for someone when I go on a trip?

Let school staff members ride school buses whenever feasible.

Pick an area for staff meetings which requires the least amount of driving for all concerned. Insist on car pools.

MISCELLANEOUS

Develop specifications for the purchase of new equipment to insure that it is designed to use the minimum amount of energy within the requirements of performance, longevity, and maintenance.

Explore the concept of installing a total on-site generation of electrical energy to improve on the efficiency level of remote generating stations.

Explore the possibility of using solar and other "alternate" sources of energy in new and existing facilities.

Design and print attractive, eye-catching signs about energy conservation and put them in appropriate places.

Work with city and county planners to speed up bicycle lanes. Provide adequate and safe parking areas for bicycles at schools and offices.

Encourage employees and students to bring their lunches rather than driving home or to a restaurant.

Eliminate as many meetings and conferences as possible.

Schedule major electrical power-consuming operations such as pumping water into storage tanks during off-peak hours.

Provide facilities that are the proper size that the group needs. Do not assign rooms or buildings that are too large.

Eliminate or reduce nighttime activities that require lighting.

ENERGY CONSERVATION IN THE SCHOOL CURRICULUM

. . . . . .

REMARKS ON THE IMPORTANCE OF ENERGY CONSERVATION IN THE SCHOOLS BY S. DAVID FREEMAN

. . . . . .

AN IECL BIBLIOGRAPHY OF ENERGY CONSERVATION MATERIALS PRODUCED BY STATE EDUCATIONAL AGENCIES

TABLE OF CONTENTS

	Page
The Public Schools and the Energy Crisis--by S. David Freeman	1
An IECL Bibliography of Energy Conservation Materials Produced by State Education Agencies . . .	9

THE PUBLIC SCHOOLS AND THE ENERGY CRISIS

by

S. DAVID FREEMAN

An address delivered to the Boston Conference of the
INTERSTATE ENERGY CONSERVATION LEADERSHIP PROJECT
January 7, 1975

COLORADO DEPARTMENT OF EDUCATION
201 E. Colfax Ave.
Denver, Colo. 80203

THE PUBLIC SCHOOLS AND THE ENERGY CRISIS

The Arab nations did us no favor when they ended the oil embargo last spring. If the embargo against the United States had continued over the past year, I have little doubt that by now the first process of painful readjustment would be largely behind us. Americans, as a matter of necessity, would have cut back on their lavish, wasteful use of gasoline, and other forms of energy. The air in our cities would be cleaner. Our balance of trade would be in the black rather than the red. Our foreign policy in the Middle East would not be distorted by worry over another embargo. And other consuming nations might be following our lead to stop the drain of petro-dollars that threatens to plunge the world into a prolonged recession or even depression.

But the oil embargo didn't last long enough for America to withdraw from its addiction to energy. The crisis was pronounced over by President Nixon just about the time the people and the government were beginning to face up to the consequences of a lifestyle utterly dependent on an energy lifeline that can be cut off at a moment's notice. The embargo only gave us a sneak preview of the future. But it was quite a jolt, one that touched the lives of every American. And despite the tendency of most people to go back to sleep on the issue, the energy crisis is not fading away. In fact, it is closing in on us.

The package of problems that we call the energy crisis is ushering in a new era for America and the other industrialized nations of the world. It is an era of scarcity in energy resources and materials. Hopefully, it will be accompanied by a greater abundance in moral values, love and enjoyment of our fellow human beings and the beauty of nature, as well as growth in a variety of knowledge-intensive, socially useful economic activities. But the new patterns of growth are only dimly perceived at the moment while the scarcity of energy and the continued pollution of the planet are harsh realities.

The old patterns of economic growth devoured hugh quantities of energy and materials. Such growth is now sputtering to a halt. The recession we are experiencing has a direct connection to the energy crisis because its origins are similar. The Disposable Society is in serious trouble because it is running short of cheap feedstock. And the Durable Society that must take its place isn't even part of the school curricula yet.

It is not often that public policy questions of such profound importance to the welfare of mankind can be connected so directly to the way people live and the values they hold dear. But the energy crisis is such an issue, especially if it is perceived in its full dimensions. It is also not often that the public is given a sneak preview of how vulnerable they are before real disaster hits. The painful memories of waiting in line for gasoline, and perhaps more important, the utter helplessness and fear of not knowing how bad it might get is perhaps the best thing going for policy makers and teachers alike. These memories combined with the harsh facts of today are quite useful in making mental contact as we try to re-

shape our public policies and to some extent our way of living in order to avoid a breakdown in our high-energy civilization.

The energy crisis can be the most effective teaching aid of the decade. It provides a handle for teaching students some of the most important lessons they need to learn by relating the issues to fundamental experiences in the students' lives such as where they live, how they get to school, where they go on vacation, what quality air they breathe, and where they will work when they graduate.

Educators of course have a dual interest in the energy crisis. The first is how it will affect the school lifestyle. What temperature should the classroom be? Will there be enough gas for the school buses, for the teacher's car? Will the high cost of fuel be paid at the expense of teachers' salaries? These kind of questions are very real and very important. But they merely illustrate how vitally the energy issue affects every element of society.

The direct impact of the energy crisis on the schools is but the tip of the energy crisis iceberg, the part that is plainly visible. The real challenge and responsibility of public education is to go "below water" so to speak and expose the entire problem with all of its ramifications. But exposing the problem is not enough. We must begin to hammer out a solution.

What is taught about the energy crisis in the classroom is much more important than the room temperature or even the priority a school gets in oil allocations. The energy crisis reflects a set of problems that require changes in attitudes, values, lifestyles, and methods of construction that will require many years to achieve. Unless the next generation of adults learns about the problems and the solutions in their formative years, the future is without hope. We are all going to endure some discomforts as we make the transition. And I don't ask educators or students to ignore their rights or obligations as consumers of energy. I only ask that educators give the highest priority to their role as teachers. And teachers must be extra sensitive to avoid the temptation of always concluding that what's good for the school house must be good for the country.

Teaching about the energy crisis must begin with a statement of the fundamental problems that are involved. They can be summarized as follows:

1) Runaway prices of fuels and electricity that are at the heart of the world's enconomic woes,

2) Environmental pollution from the exploitation and use of existing sources of energy that poses a clear and present danger to the health of mankind and the beauty of nature,

3) Steadily growing shortages of energy that cast a dark shadow over the prospects for economic growth as it has occurred in the past,

4) The gigantic flow of petrodollars from consuming nations to the oil producers poses a real danger of economic collapse to some European nations and could undermine democratic government or trigger a worldwide depression.

5) Continued dependence by the United States on oil from Arab nations that inhibits our ability to negotiate peace in the Middle East.

6) Problems of social equity between poor and rich Americans and among poor and rich nations that are caught up in the question of the price and availability of energy-issues that test our lip service for an equitable distribution of affluence on this planet.

The energy crisis is thus wrapped up in mind-boggling issues that are cosmic in nature. But we dare not be overwhelmed by the life or death nature of what is at stake. The implications are certainly complex and crucial but the fundamental pathways for solution are beyond dispute and easy to teach.

A worldwide commitment to energy conservation combined with research and development of cleaner sources of energy is the fundamental solution to the energy crisis. Conservation of energy must be the backbone of our policy. Cutting out the waste and extravagance in our use of energy can help solve all of the problems that make up the energy crisis. And without a sharp departure from the promotional policies of the past and the present we will continue chasing our tail and never really catch up. The necessary efforts to clean up and enlarge the world's supply of energy cannot possibly succeed in balancing the planet's energy budget unless we begin to practice conservation.

Conservation must come in three stages:

1) Cutting back on some of the wasteful uses of the cars, homes, and factories that are already built. This phase is limited because there is only so much that can be done with glass houses, gas-guzzling cars and energy intensive industries that were constructed in years past. But savings must be achieved even if it means some discomfort. Rationing is most likely necessary, if substantial savings are to be achieved with fairness to all income groups.

2) For the years immediately ahead incentives and performance standards must be enacted so that new homes, cars, factories take advantage of technology that uses less energy.

3) And for the future, new patterns of economic growth and research and development of new technology must be pursued, so that the energy requirements to sustain a high quality life can be reduced even further.

Conservation must become a new ethic in American life. Saving energy and materials in general must become as much an ingrained habit in what we do and what we build as growth and lavish consumption have been in the past. It's not just a matter of driving more slowly and heating and cooling buildings more moderately. Energy-saving means recycling metals, new designs for buildings, living closer to where you work, and for those who already have "one of each" developing goals and values for life that are less materialistic.

The reasons for teaching and adopting the conservation ethic are basic. If we are to preserve the environment and our freedom of action in foreign policy, and improve the economic health of the nation; if we are to sustain a civilization that is now dependent on energy sources that will peak out in a few short decades; if we are to buy the time to harness the sun and develop other cleaner, long-lasting sources of energy--then we have no other choice. Conservation is essential to the survival of civilization as we know it and wish it to continue.

The final report of the Ford Foundation's Energy Policy Project lays out a program for achieving a cut in the nation's energy growth from the 4.5 per cent of the last eight years to about 2% a year. Congress, and where appropriate state governments, should:

Adopt minimum fuel economy performance standards for new cars, so as to achieve an average fuel economy of at least 20 miles per gallon by 1985.

Enlarge the funding for public transportation, especially buses which can be built quickly.

Encourage more efficient space heating and cooling by making credit easily available for energy-saving investments in existing buildings, by setting higher standards for insulation and heating and cooling systems, by helping to upgrade building codes and providing technical assistance to builders.

Shift federal research and development money toward energy-conservation technology, and stress government purchases of energy conserving equipment--thriftier cars, tighter buildings, recycled materials and the like.

Encourage industry to conserve energy through prices that reflect the full costs of producing energy and other appropriate measures. This means Congress should eliminate the special tax privileges of the energy industry--oil depletion allowance, expensing of intangibles and special foreign tax credits--all of which constitute subsidies to an already rich industry. It also means abolishing promotional discounts for big electricity users and facilitating on-site generation of power to make beneficial use of waste heat.

Through these and other measures, the nation could bring its energy growth rate down to a more menageable 2% without in any way limiting economic growth, employment or household comforts. This kind of energy conservation program would pay some very handsome dividends for the nation. There would be less investment in new coal mines and oil refineries and drilling

rigs and power plants and more investment in energy-saving technologies. The result would be less inflation since investments to save energy are cheaper than investments in getting more. Slower energy growth means that net savings in capital investments over the next 25 years would amount to some $300 billion.

It would also mean that from the present to 1985 the nation could meet energy demand without resorting to developments that threaten grave environmental damage and that threaten the independence of our foreign policy. It would be possible to keep oil imports below today's level and still stop strip mining for coal in the arid West or on steep slopes in Appalachia. Alternatively, the nation could halt new construction of nuclear plants and also preserve the Atlantic and Pacific Coasts from offshore development. In any event we would buy the time to permit all of these energy sources to be developed at a more cautious rate.

These conservation measures are only the more obvious features of a broader restructuring of our economy and changing of values, especially as they relate to material goods. School officials have an important role to play in instilling in young minds that the joy of making something last can be as great as buying something new. It won't be easy. It cuts against the grain, but it is an essential lesson that leads naturally to shifting our preoccupation from possessions to intellectual and human concerns.

The energy crisis doesn't mean a Spartan life but it does mean a slower, more frugal America. There will be energy enough for decent housing space conditioning and basic appliances such as a dishwasher for all Americans if income distribution problems can be overcome. But rather than spending our lives piling up more and more things we can show the world how much is enough for the good life and gain more of our satisfactions from our minds, spirits and relations with other people.

The energy crisis is an opportunity for greatness and service. As a nation which epitomizes waste we can lead the way toward a society that can use resources with intelligent frugality and this endure. We can begin to discharge our obligations to future generations by stopping our gluttonous exhaustion of resources that must last for centuries. We can avoid putting our own destiny in the hands of the nations who are lucky enough to possess huge oil resources. And we can preserve our most basic resources--the air, water, and the land--for ourselves and our children to enjoy.

The energy crisis and the conservation response offer lessons that can set the tone for American life for the rest of the century and beyond. If properly taught it can bring to the forefront the moral and ethical values that have taken second place in so many of our lives. It can also appeal to the common sense and Puritan ethic that teaches us that a spendthrift nation must eventually come upon bad times. I hope you will join in the happy adventure of turning this dark cloud into a new pattern of life in America, one that will combine material satisfactions with the greater enjoyment and pursuit of human values.

AN IECL BIBLIOGRAPHY OF ENERGY CONSERVATION MATERIALS PRODUCED BY STATE EDUCATION AGENCIES

NOTE: This descriptive bibliography of energy-related environmental education and energy conservation instructional materials is provided by the INTERSTATE ENERGY CONSERVATION LEADERSHIP PROJECT (IECL). Many of these items are a part of the IECL clearinghouse while others were excerpted from other bibliographies.

By providing this bibliography, IECL does not wish to imply that these are the only materials available through state departments of education. Nevertheless, we have every reason to believe that this list is as complete a document as can be found with regard to energy conservation materials produced by state education agencies.

* Indicates that the material is not in the IECL clearinghouse but has been mentioned in some other bibliography.

ALABAMA

* Suggestions for Teaching Energy Conservation in Home Economics. Alabama Department of Education, Division of Vocational Education and Community Colleges, Home Economics Education, Montgomery, AL 36104.

* An Easy Understanding of Electricity, by James R. Carroll. A guide for teaching electricity experimentally. Tennessee Valley Authority, Division of Power Marketing, Muscle Shoals, AL 35660.

ARIZONA

* My Energy is your Energy, February 1974, elementary energy guide.

CALIFORNIA

The Energy Crisis in the Public Schools: Alternative Solutions. Ventura County Superintendent of Schools, County Office Building, Ventura, CA 93001 (Dr. James F. Cowan, Superintendent). This is perhaps the most comprehensive "checklist" approach to energy conservation and the schools in existence. It grew out of a series of problem-solving workshops conducted in January, 1974 in Ventura, Calif. The workshops were attended by 180 school administrators, classroom teachers, and directors of transportation, food services, and maintenance and operations. The 78-page booklet consists of a series of lists of energy-savings ideas which are simply numbered and arranged under headings such as "Transportation of Pupils," "Food Services," "Heating and Air Conditioning," etc. A brief bibliography is included.

See also:

* Energy and Careers for Tomorrow, Mooy, Len and Don Stillman, 1974. Career Education Concept Series (elementary grade level). Santa Barbara School Districts, Career Education Projects, 309 Princeton Ave., Santa Barbara, CA 93111.

COLORADO

A TEACHER'S HANDBOOK ON ENERGY. Compiled by a number of teachers, science advisors, and environmental education specialists in April 1974, under the direction of the Colorado Department of Education, Supporting Services Unit. The Handbook contains background information on energy, a series of checklists, classroom activities, a section on conservation and a bibliography. The Handbook may be obtained by writing to Dr. Calvin E. Anderson, Director, Supporting Services Unit, Colorado Department of Education, 201 E. Colfax Ave., Denver, CO 80203.

FLORIDA

Florida Master Plan and Action Guide for Environmental Education. This is a thirty-three page document aimed primarily at Florida teachers and administrators. It outlines some general plans and strategies for implementing environmental education programs. Publication available through the Bureau of Environmental Education, Department of Education, 347 Miles Johnson Building, South Duval St., Tallahassee, FL 32304.

See also:

* A Teacher's Environmental Resource Unit: Energy and Power. Center for Environmental Learning, Brevard County School, 705 Avacado Ave., Cocoa, FL 32922.

IOWA

Iowa was one of the leaders in recognizing the threat of the energy crisis to the nation's schools. It was also one of the first states to develop a comprehensive energy-environment resource materials guide. This guide, entitled Energy Materials, was published during the 1973-74 school year. It contains detailed bibliographies, including audio-visual materials, a list of classroom activities for elementary, intermediate, and secondary levels, and a brief glossary of energy terms. The publication may be obtained by writing to Donald V. Cox, Associate Superintendent for Instruction and Professional Education, State of Iowa, Department of Public Instruction, Grimes State Office Building, Des Moines, IA 50319.

KANSAS

* Energy, January 1974. Provides upper elementary students with basic information about (1) what energy is, (2) where it comes from, (3) how we use it, and (4) ways we can more wisely use the energy available to us.

* Energy and You, January 1974. Presents information regarding energy problems for Level II and III educable mentally retarded students.

MASSACHUSETTS

* The Energy Crisis--Aids to Study, January 1974. Massachusetts Audubon Society, Hatheway Environmental Education Institute, Lincoln, MA 01773. Compiled for U.S. Office of Education. Bibliography of books, magazine articles, and curriculum aids which will be useful in beginning a study of the energy crisis.

MICHIGAN

* Energy Conservation-Guidelines for Action, 1974. Contains curriculum guidelines and background information for teachers in addition to

MICHIGAN (cont'd)

sample activities used in Michigan schools. Write to Region Nine Superintendent, Michigan Association of School Administrators, 421 W. Kalamazoo St., Lansing, MI 48933.

* Greep on Energy. (K-12) Mini units designed by students to be taught to other students with teacher as facilitator. Write to Project S.E.E., Wyandotte Public Schools, 891 Goddard Rd., Wyandotte, MI 48192.

* A Guide to Teaching Resources and Supplement, 1973-74 edition. Listing of resource materials and services offered free by Consumers Power Company to teachers and schools in all communities served by the company. Write to Consumers Power Company, Educational Services Program, 212 W. Michigan Ave., Jackson, MI 49201.

NEW JERSEY

* "Energy Crisis: A Teacher's Resource Guide," NJEA Review 47: 33-44, February 1974. Reprints available from the New Jersey Education Association. This is part of three larger computer resource units.

NEW YORK

The New York State Department of Education has been extensively involved in producing environmental education materials. The most important of these publications are: Environmental Education Instructional Activities, (reprinted December 1972) (two booklets, K-6 and 7-12). In terms of their printed format, these are some of the most aesthetically pleasing activity guides available. Some chapter headings are "Survival," "Interdependence," "Scarcity," and "Social Forces."

Somewhat more inclusive in terms of disciplines covered is Living within our Means: Energy and Scarcity, which includes activities for English Language Arts, Social Studies, Mathematics, and Science.

For copies of these publications write to: Environmental Education, University of the State of New York, State Education Department, Albany, NY 12224.

See also:

* Coping with the Problems of the Technological Age. Parts I & II, State Education Department, Bureau of Secondary Curriculum Development, Albany, NY 12224.

NEW YORK (cont'd)

* Energy: Key to the Future. Teaching techniques for the understanding and conservation of energy, K-12, February 1974. Dutchess County Board of Cooperative Educational Services, Route 1, Salt Point Turnpike, Poughkeepsie, NY 12601.

* Our Spaceship Earth--Needs More Fuel, 1974. Illustrated booklet on energy, grades 4-10, with teacher's guide. Utilities Educational Services, Division of Custom Comics, Inc., 10 West 19th St., NY 10001.

NORTH CAROLINA

Environmental Education Strategies for Wise Use of Energy. Division of Science Education, North Carolina Department of Public Instruction, Raleigh, NC 27611. This 71-page K-12 guide provides instructional activities, energy "IQ" tests, charts, checklists, and a bibliography. The Appendix contains a number of useful graphs and other "visuals."

See also:

* America Runs on Electricity--The Energy Crisis, grades 5-9. Environmental Education Center, 13 Veterans Drive, Oteen, NC 28805.

OHIO

* Guidelines for the Teacher. Toledo Public Schools, Environmental Education Program, Manhattan and Elm, Toledo, OH 43608.

OREGON

Energy Crisis: Teaching Resources. A publication prepared for Oregon's "Energy Crisis Week" suggests school activities which stress individual responsibility toward energy crisis problems. This 60-page document includes a bibliography, checklists, and graphs and charts indicating energy usage and expenditure. (Reprinted September 1974.) Oregon State Department of Education, 942 Lancaster Driver NE, Salem, OR 97310.

A Handbook of Environmental Encounters. This impressive handbook presents a number of "encounters" using authentic and simulated situations which relate to various environmental categories (i.e. Air, Water, Land Use Priorities, Energy, etc.). Each encounter, or chapter, contains an "objective," a "rationale," and a number of activities. This 140-page handbook includes a bibliography relevant to each section or encounter. The handbook is loose leaf, allowing for flexibility, and is attractively illustrated. Oregon State Department of Education, 942 Lancaster Drive, NE, Salem, OR 97310. 1973 (reprinted, 1974).

PENNSYLVANIA

The Environmental Impact of Electrical Power Generation: Nuclear and Fossil; for Secondary Schools and Adult Education (1973). This publication discusses U.S. energy production and demand. It describes a number of energy sources (most notably coal and atomic energy). It contains a brief chapter on energy conservation bibliography, and a glossary of terms. The document was produced by: The Pennsylvania Department of Education, Division of Science and Technology, Bureau of Curriculum Services, Box 911, Harrisburg, PA 17126.

Also of some interest to educators is Energy for Pennsylvania: An Action Plan for Energy Management in the Commonwealth of Pennsylvania (rev. April 1974). A document submitted to Governor Milton J. Shapp by the Governor's Science Advisory Committee.

Note: The Pennsylvania Department of Education has also produced an environmental Film Series entitled "But Where Will the Earth Land." Audio tapes of energy/environmental presentations are available by sending blank tapes to AUDIO-VIDEO DUPLICATION CENTER, BUREAU OF INSTRUCTIONAL SERVICES, DEPARTMENT OF EDUCATION, Rm. 321, Education Building, Box 911, Harrisburg, PA 17126.

See also:

* Energy: A Technological, Economic or Moral Crisis? By John H. Anderson, University of Pittsburgh, Department of Physics, Pittsburgh, PA 15260.

* The Energy Crisis: A Partial Bibliography, 1974. Compiled by Technical Publications Consultants. (mimeographed, 4 pages) Harry Hyde, Jr., and Associates, P.O. Box 429, Bryn Mawr, PA 19010.

SOUTH CAROLINA

* Conservation Curriculum Improvement Project (CCIP) guides. Energy topics in guides for Grade 5, Physical Science Grade 9, Social Studies, Grades 7, 8, 9. Available at $3.95 each through Albert H. H. Dorsey, Curriculum Development Section, South Carolina State Department of Education, Rm. 801, Rutledge Bldg., Columbia, SC 29201.

South Carolina is in the process of developing a brief publication for their school districts. Additional information may be obtained by writing to Alice Linder, Environmental Education Consultant at the South Carolina Department of Education.

TENNESSEE

The University of Tennessee has established the Tennessee Environment Center (University of Tennessee, South Stadium Hall, Knoxville, TN 37916). The TEC has produced a number of publications of interest to the general public on the subject of energy conservation.

See also:

* Energy Activities and Resources for the Secondary Student, 1974-75. Produced by the Kingsport City Schools, Environmental Education Program, Kingsport, TN 37664. Energy-related materials for the secondary level (7-12) student, including several interdisciplinary activities, for the purpose of creating within the student an awareness of energy-related problems through involvement.

* Farm Electricity. Produced by the State of Tennessee, Department of Education, Division of Vocational Education, Nashville, TN 37219, in cooperation with TVA. This publication demonstrates the fundamentals in electricity, wiring and materials, farm motors, and electrical controls, primarily for vocational teachers. Published by Vocational Curriculum Laboratory, Box 1114, Murfreesboro, TN 37130.

* Environmental Education Teacher's Handbook. Lib Roller, Coordinator, Nashville Metro Schools, Environmental Education Department, Nashville, TN.

TEXAS

Texas is in the process of developing energy-related environmental education materials. For further information write to Mr. C.S. (Bill) Story, Program Director, Science Section, Division of Curriculum Development, Texas Education Agency, 201 E. Eleventh St., Austin, TX 78701.

VIRGINIA

Virginia has developed an environmental activities guide entitled Environmental Education Guide K-12 (July 1974). It appears to be one of the best "framework" guides available. Sample "investigations" of environmental problems are provided for the teacher, each investigation centered around a specific area (i.e. "The Classroom Environment,"

VIRGINIA (cont'd)

"Transportation and the Environment," etc.) Each investigation provides a list of "goals and objectives" together with questions and suggestions for conducting the investigation. This booklet, which contains an annotated bibliography, is available through the Divisions of Elementary, Secondary, and Vocational Education, State Department of Education, Richmond, VA 23216.

In January 1974 the Virginia State Superintendent of Public Instruction published a lengthy memorandum (No. 6928) to all district superintendents on the subject of environmental education. This memo can practically stand on its own as an environmental education handbook for Virginia teachers and administrators. As a part of the "memo" all state-approved textbooks were surveyed and sections of these texts pertinent to energy conservation and environmental education were singled out. Suggestions on the incorporation of environmental education into other subject areas (English, Public Speaking, etc.) are included as are bibliographies of film and printed matter and classroom activities.

WASHINGTON

Create Tomorrow...Today: An Energy Awareness Program of the Washington State Superintendent of Public Instruction (March 1974). An attractive and comprehensive publication. This is an activities guide, a source of information on energy, and a resource book. The activities are designed for flexibility so that both group and individual efforts are provided. The publication includes a number of useful charts, bibliography, and a glossary. Interesting graphic work enlivens the format. Write to David Kennedy, Supervisor of Environmental Education Programs, Washington State Department of Public Instruction, Old Capitol Building, Olympia, WA 98504.

Energy and Man's Environment. One of the best known and certainly the most comprehensive and ambitious energy-environmental education programs in the country. EME offers a number of services to the educator including activity guides, in-service teacher seminars, and special curriculum projects. The program is unique in that it is sponsored almost entirely through funds from private industry. EME has been described as a "pioneering union between the educational and business community." EME's approach is to divide activities and objectives into the sub categories, "Utilitarian," "Scientific," "Ethical," and "Aesthetic" to encourage trans-disciplinary study. EME activity guides then use these objectives as sub-divisions in larger categories ("Uses of Energy," "Sources of Energy," etc.) Much of the illustration in the activity guide is done by elementary students. In addition to a number of good charts, the activity guide offers a glossary and a bibliography. Write EME, P.O. Box 200, Beaverton, ORE. Revised edition available September 1975.

WASHINGTON (cont'd)

A Thousand Suns. This outstanding 16mm film was developed for the Washington State Superintendent of Public Instruction for the State's Energy Awareness Week. The film is divided into three parts. Part one deals with the sun as a source of energy and with man's ability to control nuclear fusion. The second part views the accomplishments of present energy capabilities and looks at the relationship between energy use and waste. Part three presents alternatives to wasting ourselves and our plant. The 9-minute color film has won four awards within a year. The film is available from Department G.F.A., Arthur Barr Productions, Inc., P.O. Box 7-C, Pasadena, CA 91104. Purchase price $140.00; rental $15.00. For further information write to David Kennedy, Supervisor of Environmental Education Programs, Washington State Department of Public Instruction, Old Capitol Building, Olympia, WA 98504.

WEST VIRGINIA

Do We Understand Energy? A handbook relating to the use and conservation of energy. Produced by the Division of Instruction, Bureau of Instruction and Curriculum, West Virginia Department of Education, Charleston, WV 25305. A brief (14 or 15 pages) handbook describing the sources of energy (1974). It also contains energy conservation checklists and a teacher's guide to energy-related activities.

OTHER MATERIALS OF INTEREST TO THE ENVIRONMENTAL EDUCATOR AND THOSE INTERESTED IN ENERGY CONSERVATION

A Better Way to Live: A Filmstrip Manual for Environmental Education (1973). The University of the State of New York, the State Education Department, Bureau of Continuing Education Curriculum Development, Albany, NY 12224.

Children's Edition of Selected Publications on the Environment. (EPA, September 1973.) A catalog of 29 items of interest to Environmental Educators. Write to Office of Public Affairs, U.S. EPA, Washington, DC 20460.

The Economy of Energy Conservation in Educational Facilities. Educational Facilities Laboratories, 477 Madison Ave., New York, NY 10022. Price $2.00.

Energy Activities with Energy Ant. This is basically a coloring book with games, puzzles, and cut-outs. Produced by the FEA, the book is "designed to give young children a basic understanding of energy and its uses, and to stimulate their interest in learning more about energy." Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Price $1.40. Stock #041-018-00054.

Energy Conservation and the Building Shell. Educational Facilities Laboratories, 3000 Sand Hill Road, Menlo Park, CA 94025. Price $3.00 postpaid.

Energy in Solid Waste: A Citizen Guide to Saving. Citizens' Advisory Committee on Environmental Quality. A 40-page pamphlet describing energy loss involved in the country's waste disposal patterns and suggesting alternative solutions to the problem. The pamphlet illustrates, through graphs, charts, and in narrative form, energy-saving potentials in recycling programs. It suggests several approaches for citizens' actions. The pamphlet contains a "Glossary of Solid Waste Terms," and a selected bibliography. The booklet is available through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Price $1.25. The stock number is 4000-00319. A 25% discount is allowed on orders of 100 or more copies delivered to one address.

Energy Perspectives: A Presentation of Major Energy and Energy-related Data. Most of the information in this 200-page document is presented in the form of graphs, charts, and maps. The main areas of interest are supply, production resource reserves, and power capacity. There is a ten-page section at the end of the document dealing with energy and the environment. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Stock number 024-000-00812-6.

Environment and Society: People and Cities (1974). Instructor's activity guide for environment and the city dweller. The University of the State of New York, the State Education Department, Bureau of Continuing Education Curriculum Development, Albany, NY 12224.

The Impact of the Energy Crisis on School Finance. An Issue Paper delivered at the National School Finance Conference, New Orleans, Louisiana, by Dr. Calvin E. Anderson, IECL Project Director. Available through IECL.

The NSTA, Energy-Environment Materials Project. Energy-Environment materials for teachers have been produced by the National Science Teachers Association under contract to the Office of Education, Division of Technology and Environmental Education. The three products which have been produced are 1) a Source Book, 2) a Miniunit Guide, and 3) an E-E Materials Guide:

The Source Book is divided into two volumes. Volume I, Energy, Society and the Environment, covers the environmental and economic effects of energy conservation and energy policy. The emphasis in this volume is on a description of the complex interactions between energy, economics, and the environment. Volume II, entitled Energy, its Extraction, Conversion and Use, is the technical, scientific part of the Source Book. In this volume is included statistical data in the form of graphs and charts. Some chapter titles from this volume are "Energy, What It Is and What It Does," "The Energy Stockpile," and "The Flow of Energy."

In addition to the 14 chapters of these two volumes, there are six technical appendices. The first two are a glossary and a brief introduction to the mathematical vocabulary of the Source Book. The other four appendices supplement the Source Book with additional scientific background material on energy, work, and power, heat and heat engines, electricity, and nuclear energy.

The Source Book is designed to provide multiple purposes for teachers. It provides them with ready reference to existing data. It can be used chapter by chapter or it can be tied together into larger units. While Volume I will probably appeal more directly to social studies and humanities teachers and Volume II to science teachers, the Source Book was designed to demonstrate in a compelling way the necessary interaction of all these areas.

The Miniunit Guide contains seven learning packages which teachers can use to involve students in energy matters. These Miniunits, which cover a varying number of classroom meetings, range in level from primary to high school. Each Miniunit is designed to be a complete unit. The teacher does not need to provide any additional material or go to any reference outside of the Source Book.

NSTA (cont'd)

The third product, an E-E Materials Guide, is an annotated resource reference. It contains four reading lists. The most important of these is a teacher bibliography, broken down into topic areas along the same lines as the Source Book and annotated so as to give the teacher a content review of each reference and appropriate source information. The three other reading lists are for students and are separated into categories K-6, 5-9, and 8-17.

The specifics of distribution of these materials are now in the planning stages. It is expected that they will receive widespread distribution by Spring, 1975. For further information or inclusion on the mailing list, contact:

John M. Fowler
NSTA-EEMP
The National Science Teachers Assn.
1742 Connecticut Ave., NW
Washington, DC 20009

The Public Schools and the Energy Crisis, by S. David Freeman. A speech delivered to the IECL Boston Conference. Available through the IECL clearinghouse, Colorado Department of Education, 201 E. Colfax, Denver, CO 80203.

Save Energy: Save Money! Office of Economic Opportunity (December 1974). Published by the institute on Energy Conservation and the Poor for the National Center for Community Action. (40 pages) Energy conservation tips for the home. Write to The National Center for Community Action Network Services: Energy, 1711 Connecticut Ave., NW, Washington, DC 20009.

Solar Cooling for Buildings. Workshop Proceedings Held in Conjunction with the ASHRAE Semi-Annual Meeting, Los Angeles, California, February 6-8, 1974. Sponsored by the National Science Foundation Research Applied to National Needs: RANN. Prepared by Jet Propulsion Laboratory, Calivornia Institute of Technology. Ed. Francis de Winter, Workshop Coordinator.

This document contains some forty articles on solar cooling. Some selected subject areas include the use of solar-assisted heat pumps, solar absorption systems, technological problems, and others. The document includes graphs, schematics, photographs, and a bibliography. It is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Stock Number 3800-00189. (231 pages) Price $3.00

1974 Solar Energy Directory. Ed. Carolyn Pesko. Distributed by Environmental Action of Colorado, University of Colorado, Denver, 1100-14th St., Denver, CO 80202. (Project financed in part through a grant from the National Science Foundation.) $15.00

1974 Solar Energy Directory (cont'd)
This massive reference work provides information on a multitude of solar projects and publications as well as information on people and institutions involved in solar research and development. The computerized format is enlivened by ink drawings, poems, and quotations.

The Solar Resource: 14 Articles on Energy from the Sun. Articles compiled from Science Magazine, Environmental Quarterly, Business Week, and other sources. Write to Environmental Action Reprint Service, 1100-14th St., Denver, CO 80202.

The State Education Agency and Energy Conservation in Educational Facilities. A paper prepared for IECL by Joshua A. Burns, Associate Director, EFL. Available through the IECL clearinghouse.

Technical Options for Energy Conservation in Buildings. U.S. Department of Commerce, National Bureau of Standards, Technical Report #789. Available as SD Catalog No. C13.46:789 from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. $2.35 postpaid. A comprehensive introduction to technical means of saving energy in both existing and planned buildings.

Your World My World. Environmental Protection Agency (1973) GPO Stock No. 5500-00079. Attractively illustrated publication dealing with air and water pollution, garbage, pesticides, etc. Explains EPA standards and objectives (48 pages). $1.50

(Later additions)

Oil Shale and Energy Directory for Colorado. Denver: Colorado State Library in conjunction with Bureau of Community Services, University of Colorado-Denver Center, 1975. 25 pgs.

Directory of agencies and organizations interested in oil shale and energy development in Colorado; address and brief description given for over 120 different agencies from business and industry, Federal/State/Local government, interstate cooperatives, environment, conservation, and special interest groups.

ENERGY CONSERVATION IN SCHOOL TRANSPORTATION SYSTEMS

ENERGY CONSERVATION IN SCHOOL TRANSPORTATION SYSTEMS

INTRODUCTION

Energy Conservation in Pupil Transportation is fast becoming a major area of concern to the educational population. School buses travel more than 2.3 billion miles annually using three-hundred-sixty-million gallons of fuel. These vehicles transport 60% of the total children attending grades K through 12.

Since the energy crunch occurred, pupil transportation has employed major conservation measures that have reduced the amount of fuel required to transport children to and from school and school authorized activities.

Here are some of the basic guidelines for sound fuel reductions in school transportation. From these guidelines, a comprehensive checklist can be developed for use by individual school districts.

TABLE OF CONTENTS

	Page
General Energy Practices	1
General Considerations	2
Driver Education Program	3
School Vehicles--Maintenance Equipment (Other Than School Buses)	4
Operation of School Vehicles and Services Which are Transportation Related	5
The Pupil Transportation System	6
Mechanical and Shop Program	6
The Driver's Role in Energy Conservation	6
School Policies Regarding Daily to-and-from School Operation	7
Routing	7
School Policy	9
Activity and Field Trips	9
Miscellaneous Supplies	10
Discussion Areas	11

SCHOOL TRANSPORTATION

Driver Education Cars & Teachers
Maintenance Vehicles
School Buses

General Energy Practices

1. Have one person in charge of all energy for transportation.

   Designate one person to be the Energy Coordinator for the school district. This person will:

   --be in touch with local, state, and federal energy offices.

   --keep all forms such as FEA forms on hand and know where, how, and when to file them, and to follow up on them.

   --keep the various departments informed of the energy situation at all times, i.e., cut back in heating fuels, bus fuels, etc., or rationing.

2. Conduct an Energy Audit--begin at all places where fuel is used.

   a. The Audit should be a month-by-month use for three years with estimates for the current year. Included should be prices, suppliers, bulk storage data, delivery dates and practices.

   b. Information should be accurate and specific, not general.

   c. Analyze fuel supply availability and current needs. Which months require the most gasoline or diesel? Which months require the least gasoline?

   d. Set up action plans.

   e. Set up contingencies for time when fuel is in short supply.

   f. Monitor programs as devised to see if they are being effectively carried out.

Remember the school which systematically identifies and evaluates its needs and supplies, highs and lows, can tailor programs more effectively in advance--rather than be caught short.

General Considerations

1. The people are very well informed by the media on the need and method of conservation and expect the schools to exert a leadership role.

2. There shall not be major operational differences between school districts within the city or local areas. Communicate with surrounding school leaders and share program ideas.

3. The problem of community support of the schools in place of program reductions extends beyond the basic program of education impact to the total program offered through school facilities including community services, adult education and recreation programs.

DRIVER EDUCATION PROGRAM

1. Automobile manufacturers should be encouraged to adjust their free loan program to permit greater use of intermediate and smaller size cars. Schools should be encouraged to use intermediate and smaller cars when available.

2. Public schools should conduct each behind-the-wheel lesson at the full capacity (4 students and the instructor) of the vehicle.

3. Driving simulation and multiple car off-street driving ranges should be utilized whenever feasible to reduce on-street behind-the-wheel driving time.

4. Cars should be stored centrally, not taken home by instructors.

5. Driver education vehicles shall be used only for driver education lab instruction.

6. Each behind-the-wheel lesson should be accomplished in fewer miles and in a limited geographic area.

7. Freeway and open highway driving should be reduced and done at reduced speeds.

8. Use winter months primarily for classroom work and put behind-the-wheel classes on during warmer and lighter days, if possible.

9. Vehicles should be equipped with steel belted radial tires with more air pressure in tires to reduce gasoline consumption.

10. Pre-test students and give credit for previous training and experience. Reduce hours based on results of pre-test.

SCHOOL VEHICLES - MAINTENANCE EQUIPMENT

(Other Than School Buses)

Car Pools

1. Make one office staff person available to help formulate car pools for office staff, janitors, cooks, and teachers.

2. Issue school parking places with priority granted to car pool riders for staff personnel and students.

Maintenance Vehicles

The good rules of maintenance apply to any and all vehicles, motors, and equipment.

1. Tune and maintain engines on all vehicles to peak performance. Correct faulty spark plugs, points, and carburetion.

2. Avoid full throttle operation.

3. Monitor use of all vehicles.

4. Keep gas tanks full to avoid excessive evaporation.

5. Drive slowly and easily the first few miles until vehicle warms up.

6. Ensure that vehicle tires are properly inflated or to the maximum safety level. Soft tires increase gas consumption.

7. Reduce speed limit of vehicles as low as practical.

8. Evaluate the possibility of satellite vehicle parking stations at the extremities of districts to avoid "deadheading" back to centralized garages.

9. Train drivers to use pre-planned starts and stops.

10. Install trip recorders to record driver and vehicle operation. Use this information to reduce use of gas and oil.

11. Use modern analyzing equipment to ensure fuel and oil economy for all vehicles.

12. Lock gas tanks to avoid theft.

OPERATION OF SCHOOL VEHICLES AND SERVICES WHICH ARE TRANSPORTATION RELATED

1. Develop an information exchange of ideas on fuel conservation between districts and with industry. Coordinate transportation with other public agencies.

2. Coordinate and consolidate pick-ups, deliveries, and messenger service between schools through the central office.

3. Make warehouse deliveries to schools on a very minimal basis.

4. Encourage all employees to ask themselves the following questions before undertaking a trip: Can someone else do it who is going that way? Can I deliver something for someone else? Can I do it on the way home?

5. Adopt policy for all trips by employees to meetings, conferences, conventions, etc. Limit amount of mileage allowance. Establish policy on distance to walk to meetings.

6. Utilize conference telephones as substitutes for small meetings.

7. Use telephone calls instead of home calls where feasible.

8. Install two-way radios to direct operation or redirect district vehicles to reduce mileage.

9. Request that all district employees form car pools when traveling on official business.

10. Coordinate conferences out of district for sharing rides. Use a central location as place of embarkation.

11. Have district personnel, who service a number of schools, coordinate trips to include as many stops as possible and include other district personnel serving the same schools.

12. Explore the idea of setting up a dispatcher system so that maintenance crews would not be making duplicate trips to various schools.

13. Develop a system for ordering supplies for all departments so as to keep deliveries at a minimum with a maximum load per trip.

14. Communicate with all related organizations, i.e., PTA, Board of Education, to share ideas ... and car pools.

THE PUPIL TRANSPORTATION SYSTEM

Mechanical and Shop Program

1. Tune and maintain engines, plugs, points, and timing. Maintain and clean pollution controls.
2. Keep gas tanks full to avoid excessive evaporation.
3. Ensure that bus tires are properly inflated. Soft tires increase gas consumption. Inflate to maximum safe level.
4. Replace as soon as possible buses that use excessive amounts of gasoline.
5. Keep gasoline tanks locked with one person in charge of fueling of buses and other school vehicles.
6. Keep accurate bus records for maintenance and fuel consumption, oil changes, lubrication, etc.
7. Be sure that all changes are done at the proper mileage level.
8. Inventory all parts and supplies and order for a full school year on a planned need basis, with best price.
9. In winter climatic areas, keep all buses under cover rather than allowing drivers to take home and park.
10. Use satellite bus parking stations at the extremities of districts to avoid "deadheading" back to a centralized bus garage.

The Drivers' Role in Energy Conservation

1. Retain experienced drivers as long as possible.
2. Re-educate bus drivers toward better fuel economy.
3. Reduce warm-up time on buses to 2 minutes initially and 3 minutes prior to starting routes. Drivers should dress warmer rather than running engines at full idle to heat buses.
4. Drive slowly and carefully the first few miles until vehicle warms up.
5. Avoid full throttle operation. (Place governors on engines?)
6. Avoid the "red line" even in shifting gears.
7. Drive slowly back to the bus yard.

8. Reduce speed limit to as low as practical.

9. Avoid Courtesy stops.

10. Train new drivers on existing runs while bus is "deadheading."

11. Use simulators to reduce behind-the-wheel training in vehicles.

12. Increase frequency of driver inservice programs.

13. Do not warm up bus early to let heaters work. Allow heater to warm during trip from garage to first stop. (Drivers should dress warmly during winter months.)

14. Train drivers to use pre-planned starts and stops for less gas consumption.

15. Hold joint workshops with maintenance and driver personnel to improve operation.

16. Use an incentive system for reducing vehicle fuel consumption.

17. If bus drivers have split shifts, determine if their last route ends near their homes. If they do, have them take the bus home during the mid-day period. This will eliminate the extra driving that results from a driver bringing the bus back to the terminal, driving his car home, driving his car back to the terminal, etc.

School Policies Regarding Daily to-and-from School Operation

The School Bus Operation: Routing

1. Fill buses to legal capacity.

2. Re-evaluate your routing to make it as efficient as possible.

   a. Consider letting one bus bring children of all ages in from remote and longer runs using a central drop-off spot for their regular bus in town to pick them up for deposit at correct school.

   b. Stagger school hours to the extent that you are able to utilize buses to maximum load levels--not necessarily to grade levels.

   c. Utilize computerized routing facilities, if available. Eliminate overlapping of routes if you have any, whether it is between districts, schools, or several contractors.

d. Use "zone loading" with designated stops spaced as far apart as is feasible. The bus makes fewer stops to load more pupils at the most centrally located areas. (Keeping on the time schedule becomes critical to the success of this method.)

e. Have rural students walk up to the main road for loading. (Ride bike, parents bring them, etc.)

School Bus Operation: General

1. Have older students walk to central pick-up points.
2. Lengthen distances between pick-up points.
3. Avoid courtesy stops.
4. Plan stops on level instead of on inclines.
5. Consolidate loads.
6. Plan routes to make only right-hand turns to save on idling time where safety in routing permits.
7. Use intercoms on buses to reduce stops for controlling discipline.
8. Reduce weight by removing luggage racks, extra tire, chains, etc. (during warm weather).
9. Install 2-way radios to direct operation or redirection of buses to avoid unnecessary use.
10. Monitor use of vehicles. Install trip recorders to record driver and vehicle operation. Use this information to reduce use of gas and oil.
11. Use modern analyzing equipment to ensure fuel and oil economy.
12. Use the smallest practical vehicle for long-distance, light-load runs.
13. Schedule bus routes to avoid driving up hills; stay on main roads only.
14. Let school staff members ride school buses whenever feasible.
15. Use bus contractors if available. (Escalation clauses.)
16. Hold joint workshops with maintenance and bus driver personnel to improve operation of vehicles.
17. Emission controls; i.e. catalytic converters, additives.

School Bus Operation: School Policy

1. Coordinate school calendars and start and dismissal times between elementary and secondary schools of each school system.

2. Eliminate staggered dismissal times in the same buildings.

3. Increase requirements for distances children must walk to school and to bus stops (possibly controversial).

4. Overlap elementary and secondary grades and routes. Minimize staggered school schedules.

5. Eliminate trips designed for the convenience of students between school buildings.

6. Encourage pupils to ride school buses in lieu of their own motor vehicles.

7. Eliminate buses for detention students.

8. Limit student parking, encourage high school pupils to ride school buses, form car pools, etc.

9. Explore the satellite concept where classrooms are located away from a central campus. Rent unused houses, churches, and other buildings.

10. Develop innovations and creative programs to encourage students and staff to walk to school or ride bikes. Furnish adequate bike racks. Provide adequate safety for bikes from theft and vandalism.

11. Combine deliveries with bus routes. Use buses for deliveries where and when feasible.

12. Use school buses for public service, youth transportation, elderly, etc., in off hours. Availability of fuel will be key to this supplementary type of service. (Fuel allocations to community service groups will be possible when private passenger cars are not able to buy fuels. Also, if rationing becomes a reality, some planning will be necessary, especially in small, rural areas where people might be without supplies, medicines, etc. Empty buses going one way could be utilized with planning and communication.)

School Bus Operation: Activity & Field Trips

1. Surveys show field trips use 7% to 10% of fuel allocation totally consumed for transporting pupils to and from school during the 1972-73 school year.

2. Reduce or eliminate all but the most necessary athletic contests.

3. Reduce or eliminate all but the most necessary field trips.

4. Combine field and athletic trips for more than one school.

5. Have districts share buses when holding athletic events.

6. Establish minimum and maximum distances for field trips and athletic trips.

7. Limit field trips to full bus loads only. (Perhaps picking up from several schools en route to game.)

8. Combine athletic schedules so several games can be played at the same time.

9. Encourage parents to pool with other parents in transporting children to school for late activities and for extra curricular events. Provide professional help if additional insurance coverage is needed by parents. Arrange for low cost premiums. Consider having the district assume some of the insurance costs.

10. Contract with parents to provide transportation.

11. Use charter and public transportation and their loading and unloading stops where feasible to drop off rather than return to school or homes.

12. Connect schools with cable TV or closed circuit TV for instruction, inservice meetings, and reports.

13. Use shuttle buses for students to and from athletic contests.

14. Review and evaluate all security measures in the district. Make changes to take care of any increased problems resulting from the energy crisis.

15. Change legislation which caused some buses to have capacity reduced.

Miscellaneous Supplies
(Lubricants, Additives, Accessories, etc.)

1. The smaller supply of antifreeze has placed it in critical demand because of the energy crisis. As with fuel, antifreeze availability and increased costs have put it in a high priority profile with fuel and therefore must be reckoned with when we discuss the areas of energy conservation.

2. Tips for antifreeze:

   a. Check your radiators for leaks, rust, clogging, etc.

b. Use only the needed amount of antifreeze as mean temperature dictates.

c. Covered or heated bus garages eliminate frozen radiators and cracked blocks.

Discussion Areas

1. Tires: radials appear to increase mileage

2. Reasons for warehousing where practical:

   a. Bulk Purchasing
   b. Inventory and Audit of Supplies (How Frequently?)
   c. Purchase Orders and Requisition System
   d. Regulated Personnel Handling of Supplies

3. Gasoline vs. Diesel Engines: recommend annual review for districts

4. Locked Gas Pumps (metered fuel record)

5. Regular Bus Maintenance Records (should be kept and updated as needed)

This publication was financed by funds provided by the Elementary and Secondary Education Act of 1965 (Public Law 89-10, Title V, Section 505). However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S. Office of Education and no official endorsement by the U.S. Office of Education should be inferred.